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REPORT

Medical-Biological, Epidemiological, Dosimetrical, Computer-Informational, Administrational Activities for Implementation of Joint BelAm Scientific Protocol for the Studies of Thyroid Cancer and Other Thyroid Diseases in Belarus Following the Chernobyl Accident in the Framework of Invoice for the period of 01.04.1999 - 30.06.2000

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MINSK, 2000

TASK No. 1: THE MANAGEMENT AND ADMINISTRATION OF THE BELAM THYROID STUDY

Milestone 1: Weekly meetings with the group leaders to discuss the progress of the Project, and their reflection in the minutes

For the second quarter 10 working meetings were conducted with Project Units Leaders. Weekly the Leaders reported for performed activity. All planned measures have been performed. A separate meeting was dedicated to a new format of quarter scientific report. It was recommended to prepare reports in accordance with the new format.

During the meeting there were also discussed questions concerning fulfillment of the annual working plan in the framework of the Project.

Some other questions were discussed:

1. Screening activity in the Gomel Dispensary.
2. Scheduling of Minsk mobile team activity. The schedule has been agreed by Health Care Authorities of Gomel and Mogilev oblasts and Medical Directors of the raions.
3. Laboratory examinations of blood and urine and data transfer to the specialists of the Dispensary and DC.

Milestone 2: Administrative support of cohort establishment to supply access to various informational sources especially sources of address information

For the reported period administrative support was provided in Rechitsa, Bragin, Khoiniki, Slavgorod, and Chericov. Medical Directors of Central Regional Hospitals and physicians of villages medical stations were involved to work. The Dispensary of Radiation Medicine provided with a van for field trip which brought the specialists and the patients to the places of examination

Field trips expenses have been covered to specialists who worked in field team.

Milestone 3: Coordination between Belarus and U.S. participants with respect to all activities of the Project

Coordination between Belarus and U.S. participants covered the following items:

1. Coordination of visits of the US specialists to Minsk in 2000. A schedule of visits have been prepared.
2. Conducting a meeting with ACERER group 16-19 April, 2000.
3. Conducting a plenary meeting of Belarus and US specialist summarizing the results of visits to Gomel and Khoiniki 5-10 June, 2000.
4. Revision of ISTC documents considering comments of Minsk ISTC office. The documents have been reviewed by Minsk office and submitted to the Central ISTC office (Moscow) for consideration.
5. Conducting a working meeting of dosimetrists from the USA, Belarus, Russia and Ukraine in Minsk, and epidemiologists from the USA, Belarus and Ukraine in Kiev.
6. Updating of the subcontract between the Columbia University and RCIRME. The subcontract was signed by the Director of RCIRME and passed to the US side.
7. Improvement of reagent delivery. It was decided to inform NCI monthly with respect to received shipments and notify BRAHMS of terms of shipment.

Milestone 4: Prepare materials for publication in newspapers and radio broadcasting aimed at Project promotion in mass media

In order to explain to population the benefits of participation in BelAm Project articles were prepared and issued in the local newspapers.

Project Deputy Director made a TV presentation where he informed about BelAm project.

There were conducted 5 meetings with medical community in the places of mobile team activity.

TASK No. 2: THE ESTABLISHMENT OF THE COHORT OF SUBJECTS FOR STUDY

Milestone 5: Work to locate provisional cohort of 12.000 and select at least 2.100 accessible to the Minsk Dispensary and to the mobile team

(Data Coordinating Center)

Activity aimed at location of provisional cohort subjects and their invitation to screening examination was performed inside the file of 39188.

During the reported quarter in order to locate cohort subjects DCC received data bases of Sasakava Foundation and Chernobyl Registry of Gomel city. By the time of receiving of mentioned DBs number of non-located subjects was 16179. Table 1 presents the results of performed searching activity.

Table 1

Results of computer linkage within Sasakava DB and Gomel Chernobyl Registry

Source of searching	Number of records in the file	Number of non-located subjects		Number of located subjects in the file	
	Abs	Abs	%	Abs	%
Sasakava	15764	16179	100	554	3.4
Chernobyl Registry	115989	16179	100	1077	6.6

As a result of performed searching activity in the address offices of Gomel and Minsk and in order to invite to participation those who does not want or does not have opportunity to come to Minsk for examination arrays of information have been prepared that allowed to conduct examination of subjects through three trends:

- Examination in the stationary center, Minsk
- Examination by mobile teams of Minsk Screening Center
- Examination in the stationary center, Gomel.

Table 2 reflects the results of examination conducted by mobile teams of Minsk Screening Center. For examination by mobile teams there were taken newly located subjects as well as subjects having the following statuses in the data base: no response within a month, having given preliminary consent but absent from examination, reserve, located new address.

Table 2

Examination conducted by mobile teams of Minsk Screening Cenre

Raion	Time period of mobile team activity	Number of invited subjects	Number of subjects undergone examination	
			abs	%*
Rechitsa	09.04.2000 – 16.04.2000	511	217	41.5
Bragin	14.05.2000 – 20.05.2000	666	199	29,9
Khoiniki	05.06.2000 – 09.06.2000	792	96	12,1
Slavgorod Cherikov	16.06.2000- 22.06.2000	425	112	26,4

*- % from the number of invited subjects.

To examine subjects by stationary teams of Minsk Screening Center and Gomel Branch subjects with newly located addresses (by the results of searching in Gomel and Minsk address offices) and subjects having the following statuses in the data base: no response within a month, having given preliminary consent but absent from examination, reserve, located new address have been invited (Table 3):

Table 3

Examination of subjects conducted by stationary screening centers of Minsk and Gomel

Searching source	Period of invitation to screening	Number of invited	Number of examined	
			abs	%*
Minsk Screening Center	1.04.2000 – 30.06.2000	4080	539	13,2
Gomel Screening Center	1.04.2000 – 30.06.2000	718	112	15,5

*- % from the number of invited subjects.

(Epi Group)

At the end of 1999 the cohort of locating subjects was enlarged to 39K. Lists of provisional cohort subjects were sent to the Address Offices of the Republic. In the first quarter 2000 such list was sent to the Mogilev Address Office in order to locate 2677 provisional cohort subjects. Table 4 presents the results of searching activity

Table 4

Outcomes of provisional cohort subjects locating through Mogilev address offices

Outcomes	Abs.	%
Located address	894	33,4
Not found	1710	63,9
Moved inside Belarus	54	2,0
Non-acceptable by age	3	0,1
Imprisoned	2	0,07
Death	4	0,1
Moved out of Belarus	10	0,4
Total	**2677**	**100**

From the data presented in the Table 4, it is evident that 894 subjects have been located that is 33,4% from the total number of subjects being located.

For the second quarter 4804 subjects have been invited to the examination to Minsk and Gomel Screening Centers, and 2392 subjects have been invited to the examination performed by Minsk mobile team.

In general, to provide a patient flow to screening examination 7196 invitational letters (including 6706 – to a base line visit, 179 – to repeated, and 311- to the follow up visit caused by medical reasons) have been sent to provisional cohort subjects in the second quarter.

Milestone 6: Determine the location of geographical areas with great number of people with identified current addresses for possible examination by mobile teams.

In the second quarter of the current year there were defined 5 raions (3 of them are from Gomel oblast, and 2 – from Mogilev oblast) were the majority of provisional cohort subjects live.

In April-May epidemiologists moved to Rechitsa and Bragin raions of Gomel oblast, in June – to Slavgorod and Chericov raions of Mogilev oblast. The main task of these visits was to provide patient flow to examination and verification of their addresses through personal contacts with local medical staff. To fulfil this task the following measures have been undertaken: transportation of subjects to the places where mobile team operated, mobile team visits to village medical stations to conduct screening, cooperation with local medical staff, cooperation with local mass media..

As a result of performed measures 628 subjects have been screened including patients who have come to examination without invitation. The highest percentage of those undergone examination was in Rechitsa raion (44,4 %).

Milestone 7: **Conduct epidemiological interview of the cohort subjects to find out the ways of intensifying of cohort establishment.**

In the second quarter epidemiological interview of the cohort subjects coming to examination to Minsk Dispensary was not conducted.

Milestone 8: **Continue creating initial data base of exposed "in utero".**

In the 2-nd quarter Epi Group continued creating initial data base of «in utero»exposed. For the period of 01.04.2000 - 30.06.2000 information on 5184 indvs has been entered. By 01.07.2000 the DB contained information on 75309 children born in Belarus in the period of April 26, 1986 – January 31, 1987.

TASK No. 3: THE INVITATION AND SCHEDULING OF SUBJECTS FOR ENDOCRINOLOGIC EXAMINATION

Milestone 9: **Preparation of the letters of invitation, software, and procedures for inviting and scheduling subjects for examination.**

(Data Coordinating Center)

Starting the 2-nd quarter it was planning to invite subjects to repeated visits. That is why DCC started developing model of invitation to the subsequent visits which will lead to changing of the DB structure and some changes in screening forms.

There was worked out an annex for follow up invitations i.e. more often than once a year.
Subjects flow of follow up visits consists of:

- Scheduled visits appointed by endocrinologist by the result of screening examination
- Subjects having been invited earlier for follow up visit but did not show up because of different reasons.

All the data necessary for invitation of such subjects are formed in the end of the current month to be invited next month.
Designed software allowed to separate the flow of scheduled visits (once two years or once a year if subject was younger 18 at the time of the accident) and visits with more frequent periodicity.

(Epi Group)

For the period of 03.04.2000 - 30.06.2000 there were mailed 6864 informational letters with invitation to screening examination (all kinds of the visits). Subjects were suggested to be examined in Minsk and Gomel stationary screening centers and by the mobile team during its operation in 3 raions of Gomel oblast and 2 raions of Mogilev oblast. Table 5 presents information on letters mailed to the cohort subjects

Table 5

Information on letters mailed to the cohort subjects in the 2-nd quarter 2000

Month of visit 2000	Number of mailed letters	Type of a visit						Type of examination			
		Initial		Subseq.		Follow up		Mobile		Stationary	
		Абс.	%	Абс	%	Абс	%	Абс	%	Абс.	%
April	2154	2051	95,2	45	2,1	58	2,7	500	23,2	1654	76,8
May	2419	2235	92,4	69	2,8	115	4,8	675	27,9	1744	72,1
June	2623	2420	92,3	65	2,5	138	5,2	1217	46,4	1406	53,6
Toral	**7196**	**6706**	**93,5**	**179**	**2,5**	**311**	**4,3**	**2392**	**33,2**	**4804**	**66,8**

From the total number of mailed in the second quarter invitations 93.2% were invitations to initial examination. 33.2% of letters were sent to mobile team examination, and 66.8% to the examination in the stationary (Minsk and Gomel).

Epi group conducted analysis of subjects' responses to mailed invitations (Tables 6).

Table 6

Distribution of epi statuses among the subjects invited to examination in the 2-nd quarter (03.04.2000 – 30.06.2000)

Epi status	Total	Months		
		April	May	June
Mailed letters	7196	2154	2419	2623
Responses, including	1801	731	623	447
Refusal	10	4	3	3
Death	9	2	1	6
Wrong address	214	38	79	97
Preliminary consent to be examined in Minsk Screening Center	600	335	153	112
Preliminary consent to be examined by the mobile team	551	251	186	114
Preliminary consent to be examined in Gomel Screening Center	165	35	87	43
Moved out of Belarus	14	2	6	6
Reserve	162	49	68	45
Unacceptable by age	6	1	4	1
Imprisoned	5	1	2	2
Duplicates	27	3	22	2
Moved inside Belarus	24	-	10	14
Partial disablement	3	1	1	1
Dregs of society	9	7	1	1
Wrong identified	2	2	-	-
Without status	2362	-	186	2176
No response within a month	3033	1423	1610	-
Showed up at screening:	1231	520	395	316
Including without preliminary consent	40	-	3	37

From the data presented in the tables it is evident that in the 2-nd quarter the response has been received on 1801 mailed letters (25.0%), consent has been received from 1316 indvs (18.3%), 1231 subjects came to screening (including 40 having come without preliminary consent) that is 93,5% from those given consent; 162 indvs (2,2%)did not come for some good reasons; 2362 indvs. (32,8%) do not have epidemiology status (mailing correspondence is still under processing).

All in all 1278 subjects came to examination in the second quarter including 47 who had been invited to the first quarter.

TASK No. 4: THE ENDOCRINOLOGICAL EXAMINATION OF SUBJECTS, INCLUDING SUBSEQUENT DIAGNOSTIC PROCEDURES LEADING TO THE ESTABLISHMENT OF THE FINAL PATHOLOGIC DIAGNOSIS.

Milestone 10: Screening up to 2100 subjects, including the laboratory activity for collecting and processing of blood and urine samples.

(Screening Center)

Examination

1175 subjects have been examined for the first time.

1254 subjects have been examined in Minsk Screening Center, including 1050 – initially.

Totally 4 field trips were arranged: 3 - to Gomel oblast and one – to Mogilev. 628subjects have been examined in field, including 573 initially.

130 subjects have been examined in Gomel Screening Center (125of them – for the first time). Distribution of patients with respect to their preliminary diagnoses is presented in Table 7.

Table 7

Distribution of thyroid pathology according to the data of preliminary endocrine summary

Diagnosis	Revealed for the first time		Total	
	Minsk	Gomel	%.	Abs.
Uninodular goiter	3.7%(39)	8.8%(11)	4.3%	50
Uninodular goiter?	0.8%(8)	-	0.7%	8
Multinodular goiter	1.5%(16)	4%(5)	1.8%	21
AIT	0.5%(5)	2.4%(3)	0.7%	8
Diffusive gopiter	0.2%(2)	2.4%(3)	0.4%	5
Total	6.7%(70)	17.6%(22)	7.9%	92

(Central Laboratory)

1. Screening of subjects.

Collection end procession of blood and urine samples was performed in accordance with operational manual in Minsk and Gomel Screening Centers.

In accordance with Operational Manual the following tests have been done: TSH, Ab to TPO and TG, level of thyroglobuline and ionized calcium as well as iodine concentration in urine. Amount of work performed by the Central Laboratory in the first quarter is presented in Table 8.

Procedure of quality control while performing laboratory tests.

Procedure of QC of laboratory tests is performed in accordance with the guide for QC in laboratory procedures (GLP) which includes the sections of QC of equipment and QC of laboratory procedures. The procedure of QC consists of the following stages. While performing laboratory tests parallel estimation of biochemical-hormonal indices in the control serums. For each method not less than two control samples are used (usually with the high and the low level of estimated index).

Table 8

Amount of work performed by the Central Laboratory for the period of December 1996 - 30 June 2000 r.

ACTIVITY	I Quarter. 1999 r.	I Quarter 2000 r.	12.1996-30.06.2000
Totally examined	1702	1362	10101
Filled forms of blood collection	1702	1362	10101
Taken blood samples	1702	1362	10101
Refused from blood collection	0	0	44
Filled forms of urine collection	1702	1309	9959
Taken urine samples	1699	1296	9901
Refused from urine collection	3	13	58
Refused from urine collection following the indications of the physician	-	53	142
Performed TSH tests	2200	800	9013
T free	0	0	746
Ionized calcium	1392	1704	8792
Iodine in urine	214	1450	9698
Ab-TPO	2377	2000	8505
AB-TG	2377	2000	8596
Parathyroid hormone	0	0	84

Thyroglobuline	500	2500	7299
Key entered forms			
blood collection	1230	2441	10084
results of blood processing	2103	1839	7872
urine collection and processing	1743	1991	9228
Forms passed to the Screening Center			
blood collection and results of blood processing	0	1793	5040
urine collection and processing	0	1693	5376

Control serums are used in each run of unknown samples. Obtained results are put at Levey-Jennings Quality Control Chart. In series of test significant deviations in parallel samples have been revealed, and high values of antibodies to Tg and TPO which were not confirmed during repeated test run. Such deviations could be explained by the fact that the Central Laboratory has to use repeatedly disposable pipette tips. These tips were included to the annual purchase order but still have not come.

Operational problems.

In the 2-nd quarter like in previous there was irregular delivery of reagents. The Central Laboratory submitted the final variant of request for reagents for the second quarter of 2000 on April 10, 2000. The term of delivery was defined as April 21, but actually the reagents came on June 27, 2000, and in amount not corresponding to annual order. For example, reagents for Ab- T-4 estimation have not come at all, instead of 9,5 ml vacutainers (requirement of the Manual of Operation) 3,5 ml vacutainers have come. Needles for vacutainers also have not been delivered. There is also insufficient completeness of shipment, so in the invoice of FISHER company from March 15, 2000, 20 boxes of reagents for calcium counter was mentioned but actually there were 19. On the other hand instead of ordered disposable pipette tips we received 32,000 of court plasters, which was not mentioned in the order at all and is not used in the Project in such amount. Such attitude to regents delivery impedes the process of putting the final diagnosis.

Milestone 11: Clinical examination and verification of diagnosis in patients with revealed pathology.

(QC Group)

Examination in Endocrinology Department of RCIRME Hospital

By 30.06.2000, 49 subjects have been hospitalized. Distribution of subjects discharged from the hospital with respect to their final diagnoses is presented in Table 9.

Table 9

Distribution of subjects with respect to the final diagnoses put in the Endocrinologic Department of the RCIRME Hospital

ICD code	Nosology form	Number of patient	
		Abs.	%
193.0	Thyroid cancer, after surgery and (or) complex treatment	8	16,3
241.0	Nodular non-toxic goiter	15	30,6
241.1	Multinodular non-toxic goiter	14	28,6
244.1	Post-surgery hypothyroiditis	2	4,1
245.2	AIT	8	16,3
	Thyroid surgery	2	4,1
	Total	**49**	**100**

As it is evident from the presented data nodular non-toxic goitre dominates in the structure of pathology among hospitalized subjects.

8 thyroid FNA have been performed during the clinical stage

Treatment and examination in the National Thyroid Oncopathology Center (NTOPC)

24 subjects have been referred to the NCTOPC. Distribution of patients with respect to the diagnoses made by oncologist is presented in Table 10.

Table 10

Distribution of patients with diagnosis made by oncologist

Category	Number of subjects
Initial surgery	10
Thyroid cancer	6*
Thyroid adenoma	3
Nodular goiter	1
Scheduled hospitalization	4
Consultation	3
Did not show up	7

* Depending on the date of base line visit distribution of patients were the following: 1-st quarter 1999 – 1 patient., 1-st quarter 2000 – 3, current quarter – 1. In one patient during base line visit 04.11.97 pathology was not revealed, nodule formation was found on 28.01.99.

Milestone 12: Conduct the cytological and pathomorphological aspects of the Project

(Screening Center)

Examination of bioptates obtained in the current quarter has been performed, among them 25 cases –from the Screening Centre, 20 cases – RCIRME Hospital, and 4 cases – from NCTOP. Distribution of patients is presented in Table 11.

Table 11

Distribution of subjects depending on the results of FNA

NON-INFORMATIVE:	24% (12):	-
Screening Center	12% (3)	-
Hospital RCIRME	35% (7)	-
NCTOP	50% (2)	-
Non-neoplastic nodule	48% (24)	30% (15)
Follicular tumor	12% (6)	2% (1)
Cancer, suspicion to cancer	16% (8)	8% (4)
Total	100% (50)	40% (20)

* - from the total number of conclusions

(Pathology group)

Pathology group has made morphological estimation of hystological material of 12 patients. Pathomorphological diagnoses of 7patients were thyroid papillary cancer, one of them had diagnosis of adenoma following examination conducted in the Oncology Center. The rest of patients had the following diagnoses: thyroid adenoma –3 cases, thyroid cyst – 1 case, nodular goiter – 1 case.

Milestone 13: Expert support of screening activities.

(QC Group)

For the reported period expert revision was made of all the forms completed by the Gomel Branch, the forms of subjects with revealed pathology and selectively of healthy subjects in Minsk Center. Percentage of revealed errors varied from 5 to 10%.

60 dosimetry interview forms and 197 laboratory forms were reviewed.

When comparing diagnoses made at screening and hospitalization stages no discrepancy was revealed

There were also compared the results of palpation of 4 specialists. The data concerning thyroid enlargement were estimated as comparable. Palpable nodules are revealed more often by endocrinologist, Head of the Screening Center.

Cross logic check was made for descriptive part of thyroid sizes and degree of thyroid enlargement.

A visit to Gomel branch was arranged. During this visit there were discussion of previously revealed mistakes by the result of quality control, and training of the specialist responsible for quality control.

TASK No. 5: OPERATIONAL MANUAL AND PROJECT FORMS

Milestone 14: Updating of the Operational Manual and study forms.

By the results of activity for the previous period the following forms have been updated:
Form of Ultrasound Examination a new list of formalized ultrasound conclusions was added.
Hospitalization Form (RCIRME Hospital), Hospitalization Form (National Thyroid Oncopathology Center), Preliminary summary – section "Nodule character according to cytology data" is completed by the list of formalized cytological conclusions.

Changes have been also introduced to the *forms of blood collection, results of blood processing, urine collection and processing.*

Milestone 15: Development of instructions for filling in and data entry of epidemiological, screening, laboratory, and hospitalisation forms.

Instructions for filling in and key entry of data were modified in accordance with the changes having introduced to appropriate forms.

Milestone 16: Development of quality assurance manual.

Development of code book was continued during the quarter. The following data structures have been completed: ultrasound examination form, palpation form, FNA and cytology form. Appropriate codes have been added to blank values, and to not applicable values.

TASK No. 6: DATA MANAGEMENT

Milestone 17: Design of part of data entry software for epidemiological, screening and hospitalisation information.

In order to formalize entering information to the form of medical interview a reference books of diagnoses have been worked out. In accordance with this appropriate updating of corresponding DB was made.

Changes have been introduced to the software of *ultrasound examination form, palpation form, FNA and cytology form.* Modifications were made in accordance with the changes having being introduced to code book with respect to blank values, and to not applicable values.

Test run of software for the *form of FNA and cytological examination* was continued in DCC. By the result of test run some changes have been introduced to software.

To the DB of subjects contacts a new status was added: coming to screening without preliminary consent. Software for epidemiology data entry was updated considering new changes.

In order to improve interface for users of Epi Group and Screening Center there were worked out components of annexes for searching patients by family name, name and patronymic in epi DB and DB of the Screening Center.

Milestone 18: Data entry of epidemiological, screening, laboratory, and hospitalisation forms. Maintain epidemiological, screening, laboratory, and hospitalisation data bases.

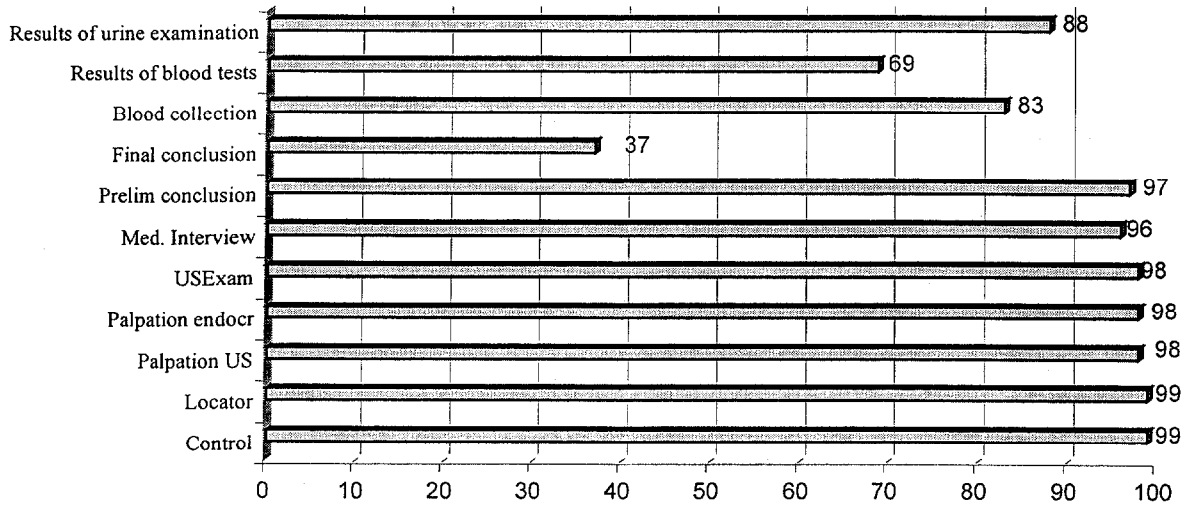


Fig. 1. Relation of key entered screening and laboratory forms to the number of subjects having been examined (%)

As it is evident from the presented figure there is a backlog of data entry of blood collection and processing, as well as final summary at screening which is caused by irregular delivery of reagents.

Actual situation in laboratory tests processing is reflected in Fig. 2

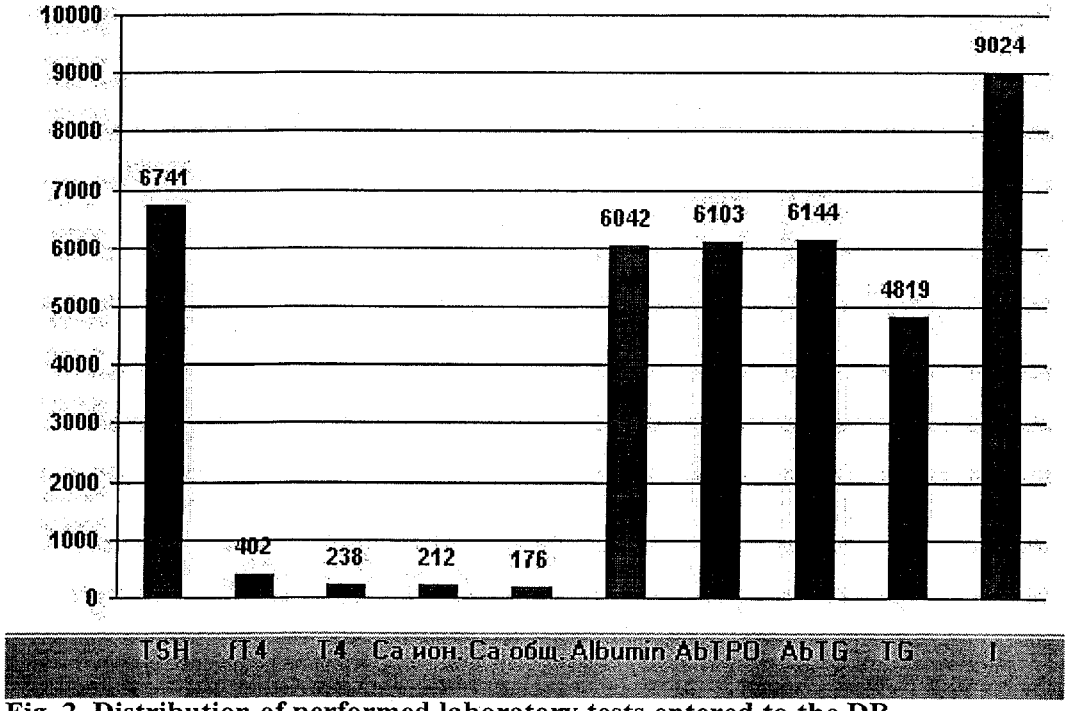


Fig. 2. Distribution of performed laboratory tests entered to the DB.

(Epi group)

In the 2-nd quarter epi group completed and entered to epi DB 4542 initial registration forms (including 2151 automatically); 6500 contact forms (including 4949 automatically). By 05.06.2000 Epi DB contains 20825 initial registration and 48092 contact forms.

Milestone 19: Transfer to the DCC file server of the data, entered in local computers of the screening center and central laboratory, and quality control of these data

(Data Coordinating Center)

For the reported period DCC staff transferred data from the Project Units to DCC server. Data came to DCC weekly through discs. While performing quality control of transferred data there were revealed logical discrepancies:

- **An automatic check was performed for:**

1. Correspondence of quantity and size of nodule indicated in the form of ultrasound examination and in the forms of Preliminary and Final Summaries of Medical Screening, keyed in the 4-th quarter. As a result 15 records with discrepancies have been found (1,14 % from the total number of entered forms)
2. Correspondence of quantity and size of nodule indicated in the forms of preliminary and final summary of medical screening. As a result 8 records with discrepancy has been found (0.3% from the total number of entered forms).
3. Lack of keyed hospitalization (surgery) forms in case if subject has been referred from the Screening Center. There were revealed 7 missed forms.
4. Lack of keyed hospitalization forms (RCIRME Hospital) in case if subject has been referred from the Screening Center. There were revealed 4 missed forms.
5. Lack of keyed hospitalization (surgery) forms in case if subject has been referred from RCIRME Hospital. There were revealed 2 missed forms.
6. There were revealed 1 case of discrepancies in the preliminary diagnoses of screening examination and hospitalization stage (RCIRME Hospital). Mentioned above cases were reviewed by experts.

Appropriate comments have been addressed to the Screening Center in order to make corrections or add missing information with further corrections to the DCC DB.

Routine control of DB on the completeness and proprietress of records was also performed.

Milestone 20: Design software for quality assurance of screening, epidemiological, and laboratory data.

(Data Coordinating Center)

In order to perform procedures of quality control of screening data the following reports on cross checks of the forms have been worked out:

1. A report has been worked out for distributing subjects with respect to thyroid grade with possibility to analyze by
   - age;
   - gender;
   - nosologic unit;
   - raion of residence;
2. A report has been worked out for revealing false-positive and false-negative results in nodules forms of thyroid pathology.

Milestone 21: Design a part of the query software for the epidemiological, screening and hospitalisation data.

- A report was working out for counting of cases of revealed diseases with respect to the age, gender, dose interval, type of conclusion, period of time.

- Software was started developing for automatic calculation of the project progress in accordance with the new format of the report.
- A report has been worked out for reflecting on the map of Belarus average doses of the settlements of Gomel oblast.

Milestone 22: Analysis of the results and preparation some progress report on the cohort selection, scheduling of screening exams, subject flow through exams and data entry.

(Data Coordinating Center).

Fig 3 presents monthly distribution on initially examined subjects for the whole period of Project activity.

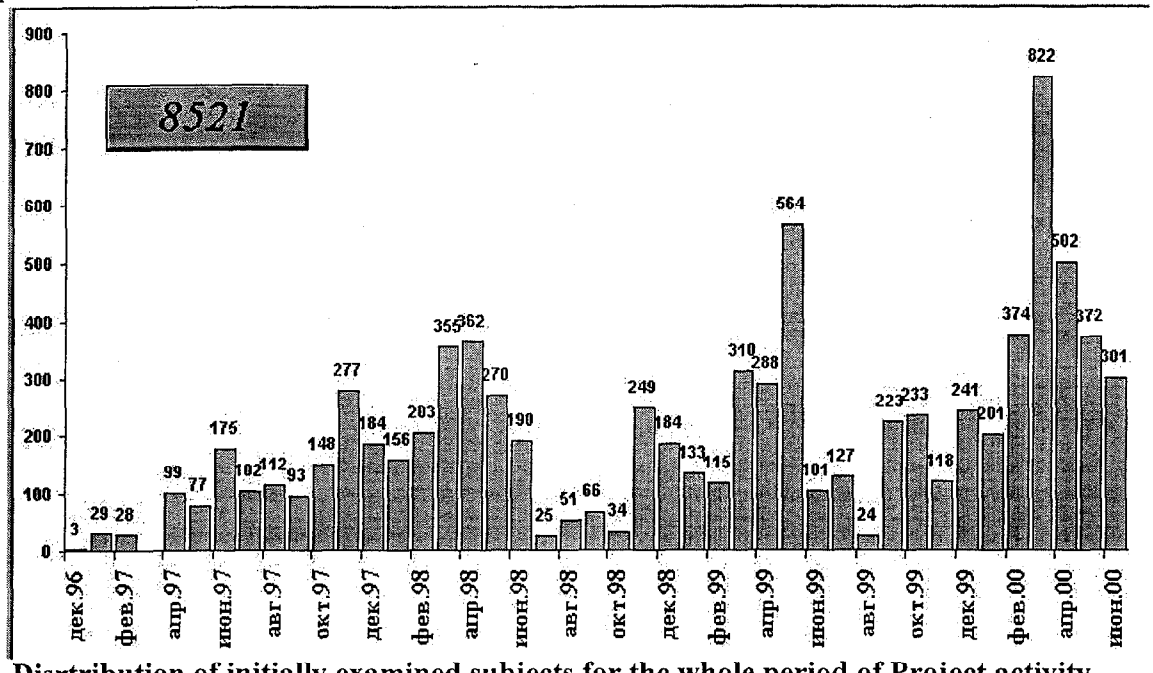


Fig. 3. Disrtribution of initially examined subjects for the whole period of Project activity

Fig.4 presents monthly distribution of subjects undergone repeated examination. The number of subjects having come to repeated examination appeared from those who had been invited early but did not come for some reasons.

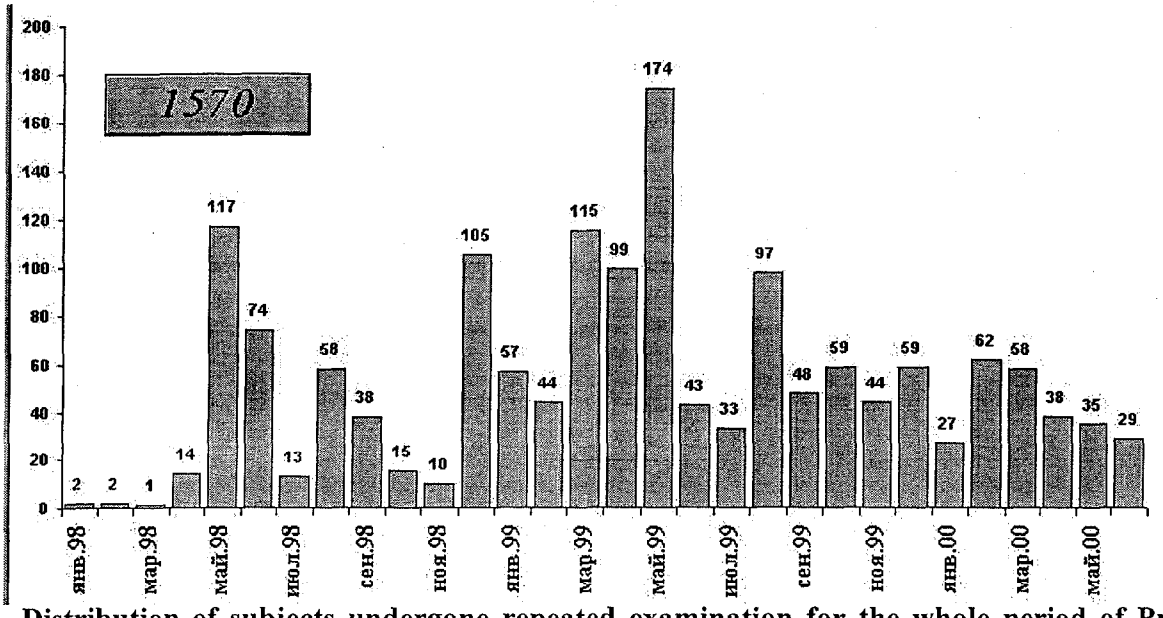


Fig. 4. Distribution of subjects undergone repeated examination for the whole period of Project activity.

Fig. 5 presents number of subjects having come to follow up visits (in 3-6 months) for the whole period of Project activity.

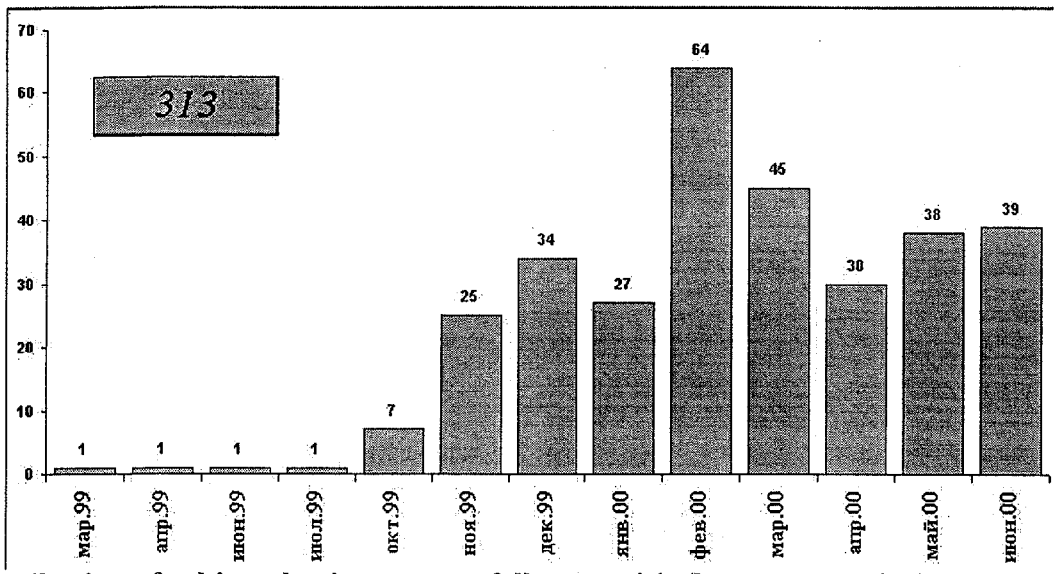


Fig. 5. Distribution of subjects having come to follow up visit (by recommendation of physician) for the whole period of Project activity

Fig 6 reflects the number of subjects undergone screening examination in the Gomel Center from the moment of its opening. The figure does not reflect exact number of those who were examined in June 2000 as far as by the time of this report the forms have not come to DCC.

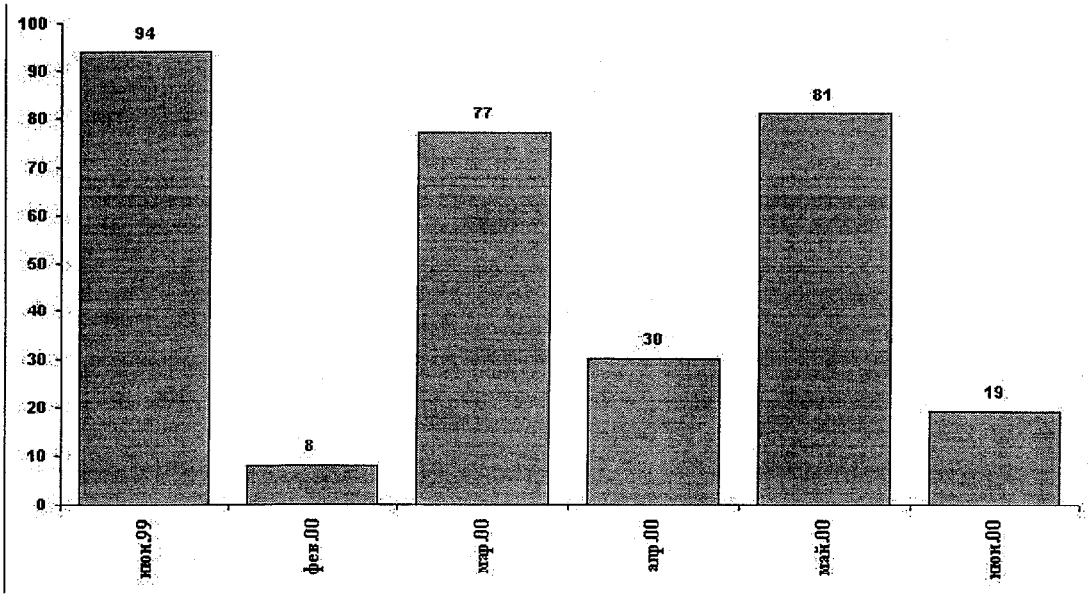


Fig.6 . Distribution of subjects undergone screening examination in the Gomel Center

(Epi Group)

For the 2-nd quarter 7196 subjects visits have been scheduled (including 6706 initial, 179 subsequent visits and 311 – follow up visits (by recommendation of physician)). 2292 subjects have been scheduled to be examined by mobile team and 4804 in the stationary)

Figs. 7 and 8 present a relationship of number of subjects given consent from the total number of invited subjects, and relation of number of subjects undergone examination from those given consent.

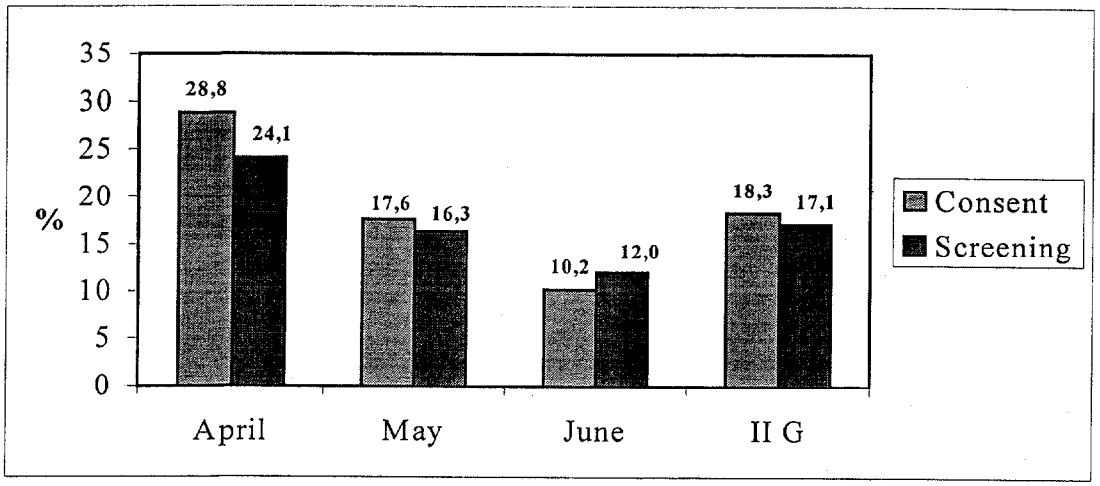


Fig.7. Relationship between the number of subjects given consent and the total number of invited subjects

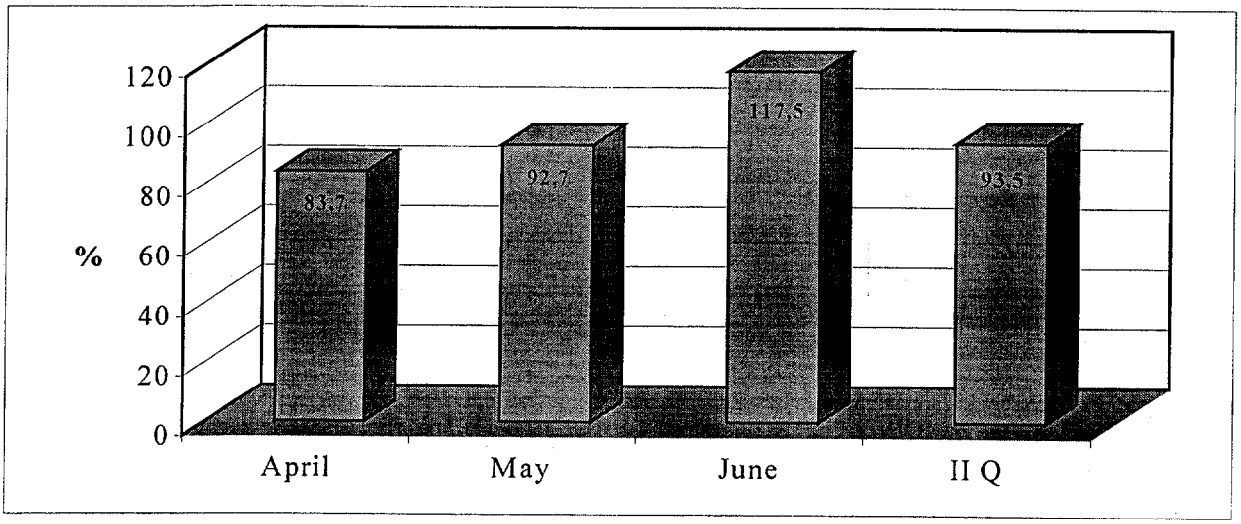


Fig. 8. Relationship between the number of subjects undergone screening and those given consent.

From the data presented in Fig 7. and 8. it is evident that in June subjects came to examination without preliminary notification of their visit.

A state of the cohort by 05.07.2000 is characterized the following way. All in all 8529 subjects have undergone base line screening examination, including 2955from high dose group, 2362– from mid dose group, and 3212– from low dose group.

Fig.9 presents the dynamics of cohort establishment.

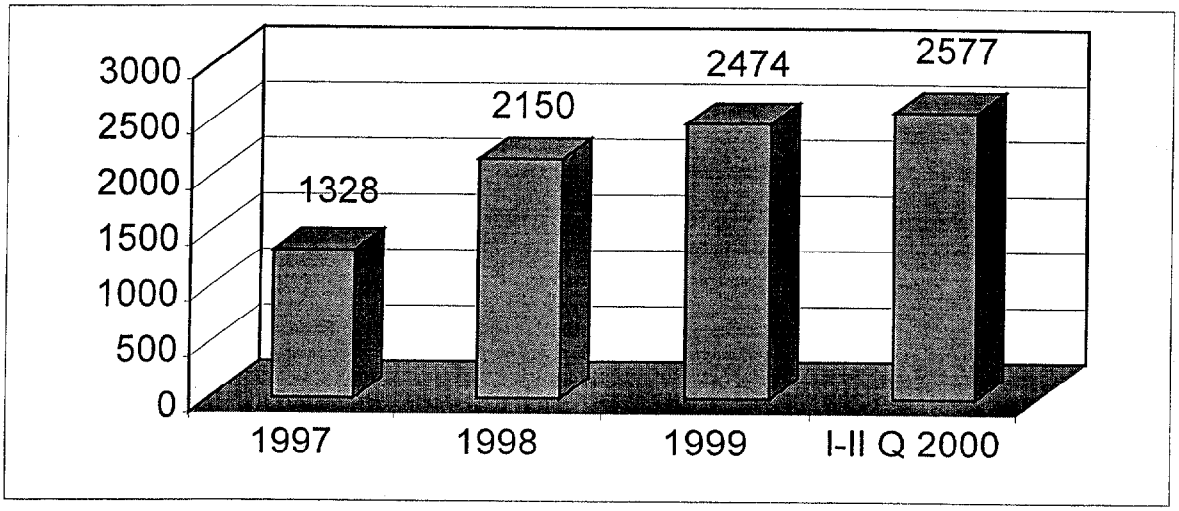
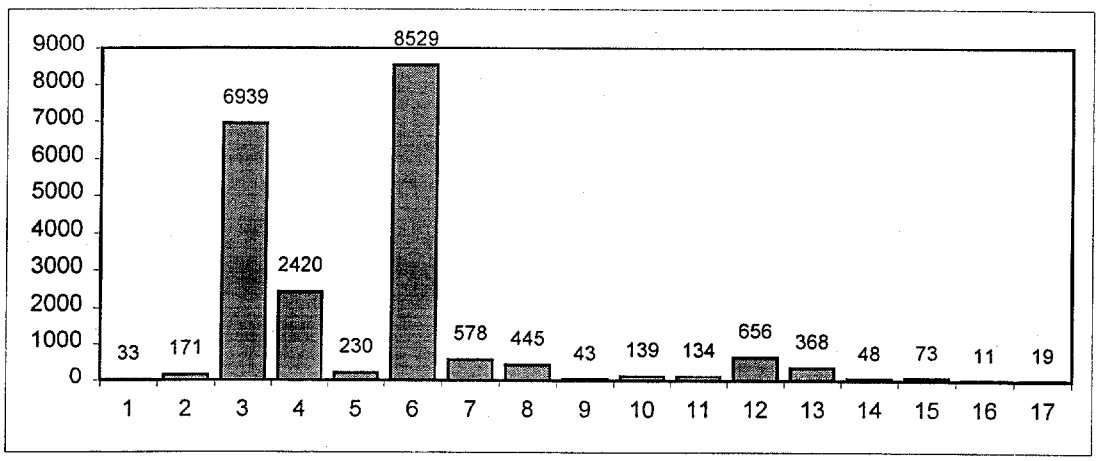


Fig.9. Dynamics of cohort establishmen for the period 01.01.97. - 05.07.2000.

Searching activity in the frames of 39 K allowed to intensify cohort establishment.

By 05.07.2000 addresses were identified for 20836 provisional cohort subjects. Among them 11,6% do not reside in the identified address; 0,16% refused from examination; 171 indv. (0,8%) have died.

Located subjects have different epidemiological statuses in the cohort (Fig.10).



1 –refusal
2 – death
3 – no response
4 – wrong address
5 – preliminary consent (Minsk Screening Center)
6 – undergone screening examination
7 – moved out of Belarus
8 – reserve
9 – unacceptable by age
10 – preliminary consent (mobile team, Minsk)
11 – imprisoned
12 – moved inside Belarus
13 – duplicates
14 – examined by Sasakava Project
15 – preliminary consent (Screening Group, Gomel)
16 – partial disablement 17 – dregs of society

Fig. 10. Distribution of epidemiological statuses among located cohort subjects

The response was received from 10203 individuals. Liabilities of the cohort - 1123 indvs. (including: 578 indvs. moved out of Belarus; 43 –unacceptable by age; 134 indvs. - imprisoned; 368 - duplicates.).

Milestone 23: Design of image processing procedures, and data base of thyroid images.

During the quarter an activity was continued aimed at setting up of data base of thyroid images.
By now 145 MOD from available 158 have been transformed from cri format to jpg and to tif.
Some modifications have been introduced to the program as far as images appeared with date of examination 2000 (y2k). The DCC server was equipped with system for thyroid images storage. The system was tested, all comments were addressed to the developers for improvement of the program.

Milestone 24: Set up DB of epidemiologica information, completion of initial abstract form (morbidity) for subjects undergone examination

Forms have been filled in and the information have been verified on the subjects with thyroid cancer (diagnosed before the Project and inside the Project).

Task No. 7: THE ESTIMATION OF INDIVIDUAL THYROID DOSES FOR MEMBERS OF THE COHORT.

Milestone 25: Conduct personal interviews for all subjects screened in the Project. Quality control of interview.

For the whole period of Project activity the total number of subjects having been interviewed is 9531 inds., 8204 of them came to base line examination, and 1327 to follow up visit.

For the period of April 1 to June 30, 2000, 1070 subjects have been interviewed, 1038 of them initially and 32 repeatedly. The information was collected in the Dispensary and in field during mobile team activity in Gomel and Mogilev oblasts.

Distribution of subjects with respect to the place of interview

	Initial	Subsequent	Total
Dispensary (Minsk)	452	15	467
In field	586	17	603
Total	1038	32	**1070**

The subjects came to interview:

	initial	subsequent	total
·on one's own	**829**	**24**	**853**
·together with mother	**175**	**7**	**182**
·together with father	**8**		**8**
·together with sister or brother	**19**	**1**	**30**
·with other accompanying	**7**		**7**
Total	**1038**	**32**	1070

Distribution of subjects' answers with respect to the quality of obtained data is shown in Table 12.

Table 12

Results of interviews with respect to the completeness of the subjects answers

Estimation of quality	initial	Subsequent	Total
good	456	15	471
satisfactory	444	12	456
unsatisfactory	138	5	143
Total	1038	32	**1070**

For the fourth quarter 4 interview forms have been completed on mothers in the period of breast-feeding.

Age distribution of cohort subjects come to interview in the second quarter is given in Fig. 11.

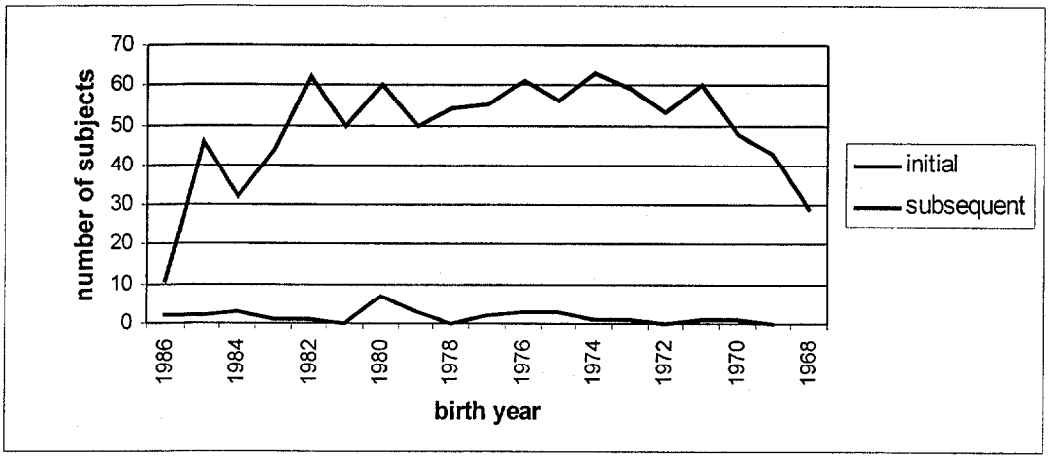


Fig.11. Age distribution of cohort subjects having been interviewed during the second quarter of 2000.

Distribution of subjects having been interviewed for the whole period of Project activity is presented in Table 13.

Table 13

Distribution of subjects having been interviewed for the whole period of Project activity 1996 – 1999 years

Year of examination	Initial interview	Subsequent interview	Total
1996–1997	1315	–	1315
1998	2120	441	2561
1999	2416	720	3136
2000	2353	166	2519
Total	8204	1327	**9531**

Distribution of subjects' answers with respect to the quality of obtained data from the initial and subsequent interviews for the whole period of 1996-2000 is shown in Table 14.

Table 14

Results of interviews with respect to the completeness of the subjects answers for the period of 1996 – 2000

year	good		satisfactory		unsatisfactory		total
	initial	subsequen t	initial	subsequent	subsequen t	initial	
1997	–	–	–	–	–	–	1315
1998	912	189	954	198	254	54	2561
1999	1034	311	731	246	651	163	3136
2000	1085	113	928	37	340	16	2519
Total							**9531**

Age distribution of cohort subjects at the moment of the accident having been examined during the period of 1996-2000 according to the information of the DCC is presented in Fig. 12).

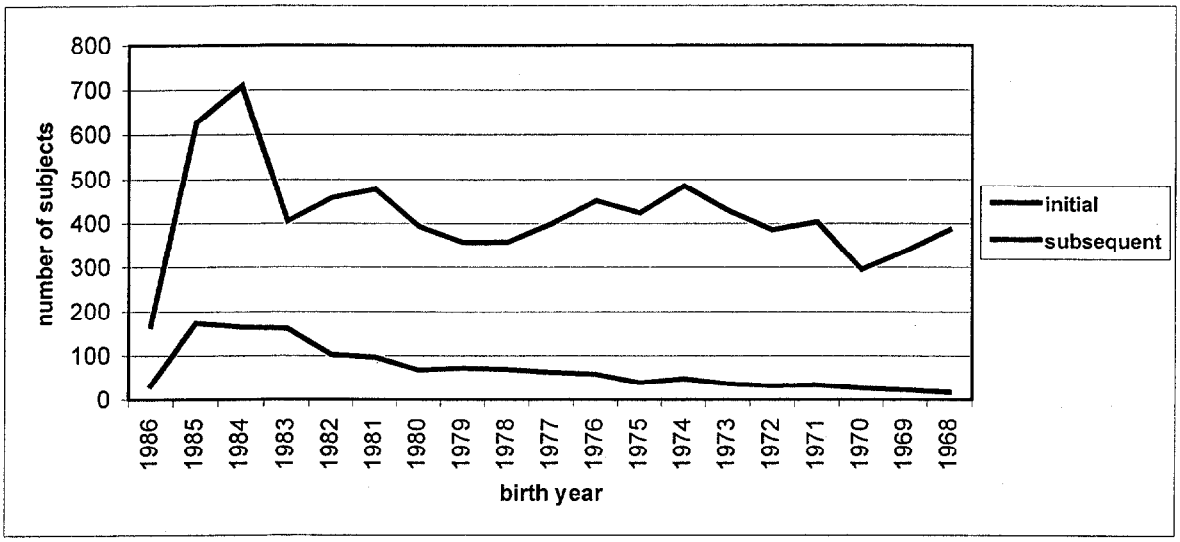


Fig. 12. Age distribution of cohort subjects at the moment of the accident having been examined during the period of 1996-2000

QUALITY CONTROL OF THE INTERVIEW.

QC of "Individual Interview Form" has been performed. It covered the period of 1.03.00 - 31.05.00. Number of completed forms for this period was 1327. Approximately each fifth interview form has been checked; so the number of reviewed forms was 281.

Table 15 presents the results of quality control of Interview Form completion 1

Table 15

# of question	Made errors	Number of error
9b	# of floor is not put in	2
15a	Type of iodine medication is not marked	1
15a	Term of iodine medication intake is not marked	1
16a	The table of milk consumption following the accident is not completed	6
16a	The dates in the table of movements (question 11) does not correspond to the table of milk consumption following the accident	7
16b	The date of milk consumption cancel is not put in (wrong)	14
16c	No answer for the starting date of cattle pasturing	9
	No quality estimate for separate blocks of questions	10

By the results of QC of completed Individual Interview Forms appropriate notes has been prepared for each interviewer. This note contains individual comments and recommendations. Each comment that should be corrected by the interviewer contains subjects ID so that it will be easy to find appropriate interview form and make necessary corrections.

Milestone 26: Enter to the data base information from the interviews. Quality control of data entry.

In the second quarter the personnel of the Dosimetry Group continued entering to the DB data of the initial interview and the repeated one. In the second quarter 655 interview forms of the current year and 940 of the previous period of 1999-2000 have been keyed to the DB. All in all for the whole period of Project activity the information on 7754 subjects has been entered.

Results of quality control of data entry

QC of data entry has been performed for the period of 1.03.00 - 31.05.00. The number of entered interview forms for the mentioned period was 892, and 111 of them have been reviewed.

Table 16 presents the results of quality control of dosimetry data entry.

Table 16

# of question	Made mistakes	Number of mistakes
3	Wrong current last name of subject	1
11	Incomplete information in the table of moves out in 1986	2
16a	Incomplete information in the table of milk consumption following the accident	2
15	Incomplete data on iodine prophylaxis	4
18	Entered information on diary products does not correspond to questionnaire	1
96	Entered number of floor in the building does not correspond to questionnaire	3
1	Wrong date of interview	1
2	Lack of information on participants of the interview	1
20	Entered information on daily ration does not correspond to questionnaire	2
16c	Lack of information of starting date of cattle pasturing	2
	No quality estimate (wrong) for separate blocks of questions	6

By the results of QC of Individual Interview Forms entry appropriate notes has been prepared for each interviewer. This note contains made mistakes of data entry and ID of questionnaires to be corrected.

Milestone 27: Estimate reliability of answers for 100 subjects through comparison of the results of initial and repeated interviews. Complete preparation of unique Belarus-Ukraine self-interview form and instruction for interviewer how to conduct initial interview.

ESTIMATE RELIABILITY OF ANSWERS FOR 100 SUBJECTS THROUGH COMPARISON OF THE RESULTS OF INITIAL AND REPEATED INTERVIEWS.

The purpose of the work was to compare dosimetry information obtained in the course of performed interview in 1988 and during the Project activity in 1997-2000.

To conduct comparative analysis of dosimetry information 100 subjects have been selected (from the total number of 121) to whom the Dosimetry Group had the results of interview of 1988 and who went through initial and repeated interview in the framework of the Project.

Interview conducted in 1988.

Interview conducted in 1988 included 5 questions:

1. Starting date of cattle pasturing in spring 1986.
2. Date of evacuation (move out) from contaminated territory in April-May 1986.
3. Iodine prophylaxis: starting date of iodine medicines intake and number of days of intake.
4. Amount of milk used to be drunk per day (liters).
5. Date of canceling of milk consumption in the period of April- May 1986.

By the results of the 1988 interview for each of 100 selected there is information on all 5 questions.

Interview conducted in the framework of the Project, 1997-2000гг.

Interview conducted in the framework of the Project, 1997-2000 included the questions listed above and other questions. Below is presented such characteristics of initial and repeated interview of selected subjects as estimation of quality of conducted interview, participants of interview, and time of interview.

Diagrams 1 and 1a present information concerning time when interview was conducted.

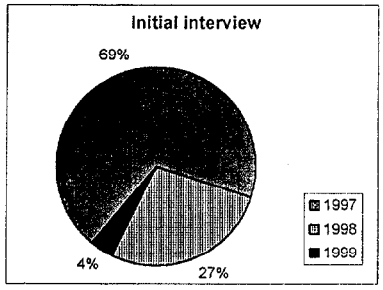


Diagram 1

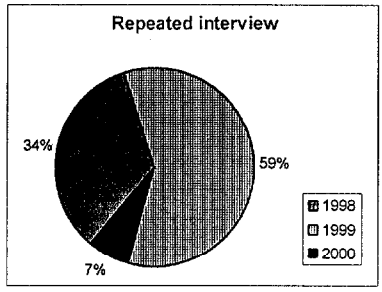


Diagram 1a.

It is evident from the presented diagrams that for the majority of subjects interval between the initial and repeated interview was at average 2 years

Diagrams 2 and 2' present an information on participants of initial interview and quality estimation of conducted interview from the point of view of the interviewer for children before 10 years of age and older than 10 years at the time of accident respectively.

Diagrams 2a and 2'a present similar information for the repeated interview.

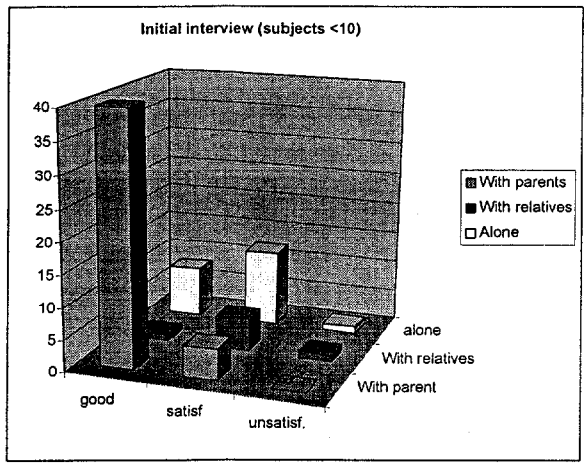


Diagram 2.

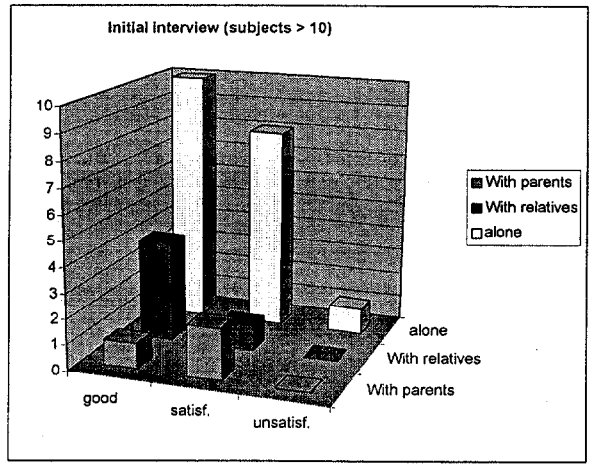


Diagram 2'.

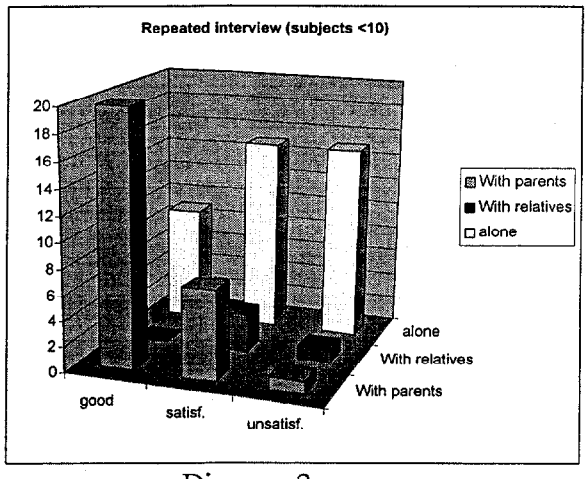


Diagram 2a.

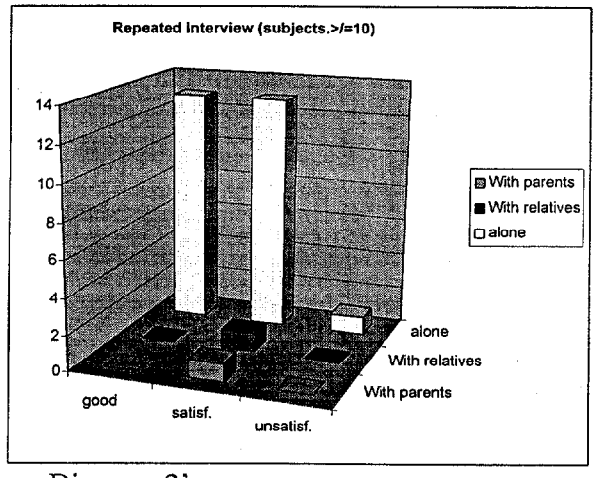


Diagram 2'a.

As it is evident from presented diagrams subjects older 10 at the time of the accident come to the initial interview together with their parents 89% rarely, and to the repeated interview 96% rarely in comparison with subjects who were less than 10 years old at the time of the accident.

48% of subjects came to initial interview together with their parents, and 29% - to the repeated interview, i.e. 40% less (38% of them were subjects < 10 years of age at the time of the accident). Only 2% of subjects appeared to initial interview without parents, but brought the parents to the repeated interview. As a result during repeated interview quality estimate of conducted interview "good" is met

36% rarely than when initial interview. And accordingly, in the group of subjects < 10 y.o. at the time of accident the number of unsatisfactory quality estimates during the repeated interview became higher.

Diagram 3 reflects relative shares of selected subjects who had the same quality estimate (good, satisfactory, unsatisfactory) during initial and repeated interviews versus those to whom these estimates were different.

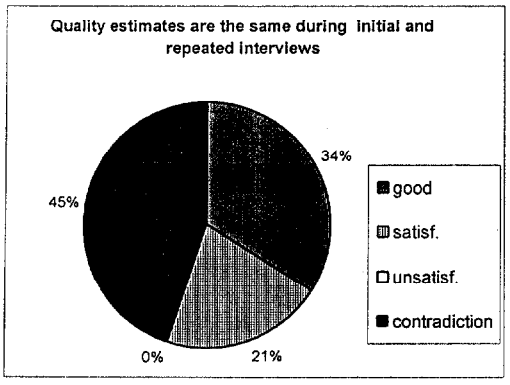


Diagram 3

Diagram 4 reflects relative shares of selected subjects who came to initial and repeated interviews alone, together with parents, with the other relatives.

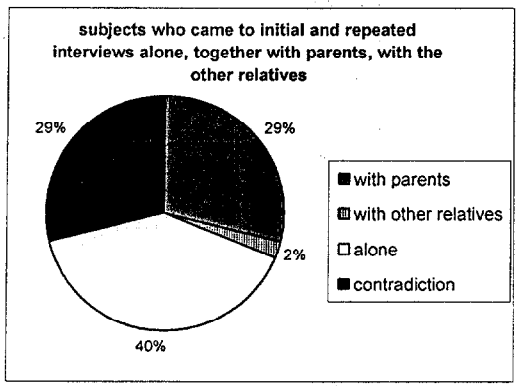


Diagram 4

Comparative analysis of the interview results conducted in 1988 and interview conducted in the framework of the Project included 5 questions listed above. In 96% of cases the results of initial interview in the framework of the Project were compared; in 4% of cases the results of the repeated interview were compared because in 2% of cases there was unsatisfactory quality of initial interview, and in 2% of cases subject came to initial interview alone and to the repeated – with mother

Comparative analysis of the results of the initial and repeated interviews conducted in the framework of the Project included 5 questions listed above and three questions in addition:

- Did the subject consume diary products in April-May 1986.
- Did the subject consume green leafy vegetables in April-May 1986.
- When did the subject start consuming green leafy vegetables

Results

I. Starting date cattle pasturing in spring 1986.

This question was included only in 40% of Project questionnaires.

That is why, when the questionnaire of initial interview did not contain given question, and the repeated interview was conducted using questionnaire containing this question, the information concerning cattle pasturing was taken from repeated interview.

The result of comparison – **similarity,** when:

1. Pasturing started before the accident regardless exact date;
2. Pasturing started following the accident and starting dates of pasturing are similar ± 1 day;

The result of comparison – **converge**, when pasturing started following the accident and starting dates varied more than one day.

Result of comparison – **lack of information**, when:

1. To the question of starting date of cattle pasturing the answer was "do not remember" at least at one interview;
2. Given question was not included to the questionnaire.

Diagrams 5 and 5a present the result of comparison for the interview conducted in 1988 and those in the framework of the Project, and initial with repeated accordingly.

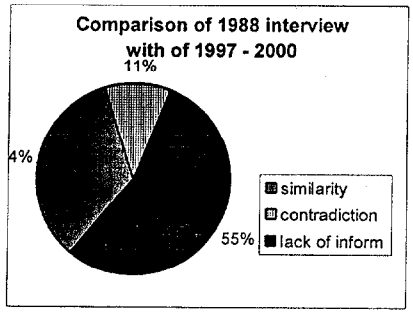


Diagram 5.

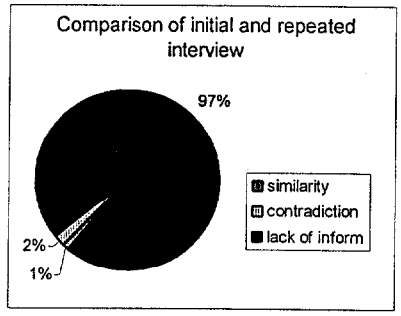


Diagram 5a.

As it is evident from presented diagrams recurrence of responses during the interview conducted in the framework of the Project as compared to interview of 1988 is 34%. As it was pointed out above this question was included only in 40% of questionnaires.

There is no need to speak about recurrence of responses while comparing the results of repeated interviews with initial because 93% of questionnaires of the initial interview did not contain this question.

II. Moves out from contaminated territory in April-May 1986.

Result of comparison – similarity, when:

1. Dates of moves out are similar ±1 день;
2. By the result of both interview the subject did not move out from contaminated territory in April-May 1986;

The result of comparison – **converge,** when:

1. Dates of moves out varied more than 1 day;
2. By the result of one interview the subject moved out from contaminated territory, but by the results of other – did not;

Result of comparison – **lack of information**, when at least in one interview the answer was "do not remember".

Diagrams 6 and 6a present the result of comparison for the interview conducted in 1988 and those in the framework of the Project, and initial with repeated accordingly.

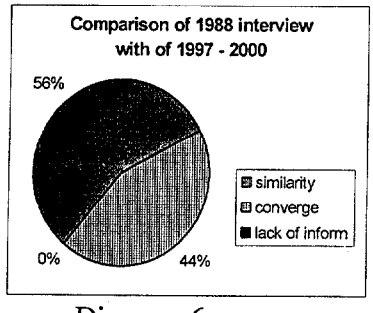


Diagram 6.

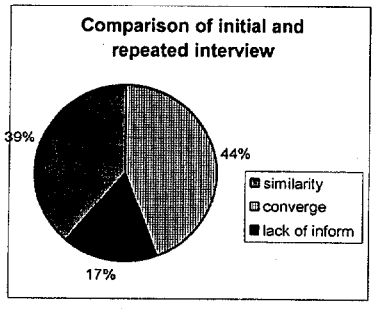


Diagram 6a.

Diagrams 7 and 7a reflect the results of converge in moves out from contaminated territories by days while comparing 1988 interview with interview conducted in the framework of the Project, and initial interview with the repeated accordingly.

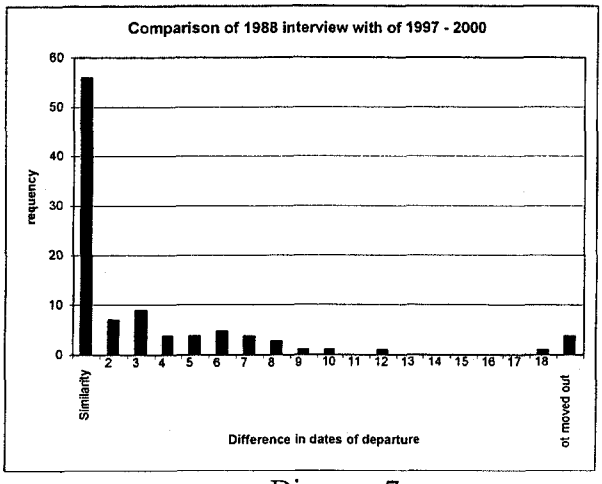


Diagram 7

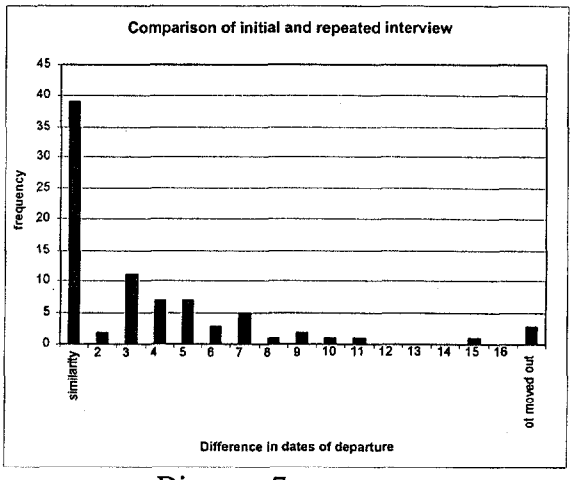


Diagram 7a

As it is evident from presented diagrams recurrence of responses during the interview conducted in the framework of the Project as compared to interview of 1988 is 56%. Recurrence of responses during the repeated interview comparing to initial one is 39 %.

Actually the fact of move out from contaminated territory disagreed only in 3% of cases while comparing interview conducted in the framework of the Project with interview of 1988 as well as while comparing the repeated interview with initial one. It means that participants of interview can recall the fact of move out rather good

III. Iodine prophylaxis in April-May 1986.

Result of comparison – **similarity**, when:

1. Iodine prophylaxis was not conducted;
2. Iodine prophylaxis was conducted and starting dates of stable iodine intake are similar ± 1 day and duration of the intake is the same. Number of days of stable iodine intake could disagree when prophylaxis in both cases was conducted before moving out from contaminated territory.
3. Iodine prophylaxis was conducted in different time but in both cases in the places of evacuation, or when in one case iodine prophylaxis was not conducted at all, and in other case it was conducted but in places of evacuation.

The result of comparison – **converge,** when:

1. from one interview it is clear that iodine prophylaxis was conducted before evacuation (move out) from the contaminated territory, and from the other interview – it was not conducted at all.
2. Iodine prophylaxis was conducted before evacuation (move out) from contaminated territory but starting dates of stable iodine intake are different.

The result of comparison – **lack of information**, when at least in one interview the answer was "do not remember".

Diagrams 8 and 8a present the result of comparison for the interview conducted in 1988 and those in the framework of the Project, and initial with repeated accordingly.

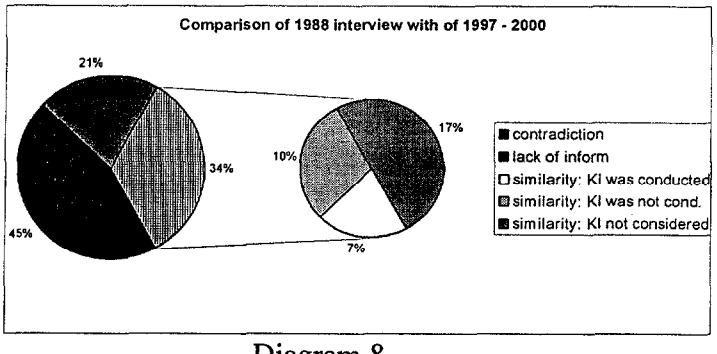


Diagram 8

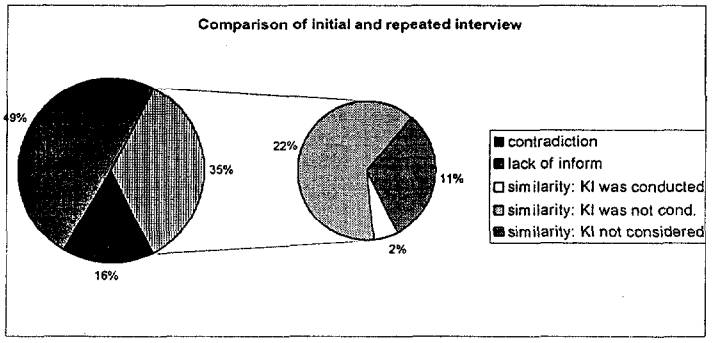


Diagram 8a

As it is evident from presented diagrams recurrence of responses during the interview conducted in the framework of the Project as compared to interview of 1988 is 34%. Answering the question of iodine prophylaxis 21% of interview participants (in the framework of the Project) gave "do not remember" answer.

Recurrence of responses during the repeated interview comparing to initial one is 35 %, and the answer "do not remember" was given in 49% of cases.

IV. Amount of consumed milk per day (following the accident)

The result of comparison – **similarity**, when amount of consumed milk per day was the same ± 0.2 l.

The result of comparison – **converge,** when:
Amount of consumed milk per day differed in 0.2 l.

The result of comparison – **lack of information**, when at least in one interview the answer was "do not remember".

Diagrams 9 and 9a present the result of comparison for the interview conducted in 1988 and those in the framework of the Project, and initial with repeated accordingly.

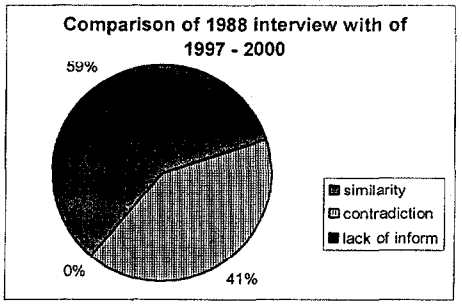


Diagram 9.

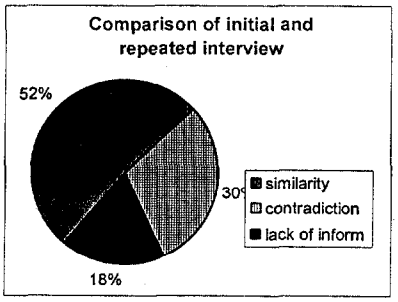


Diagram 9a.

As it is evident from presented diagrams recurrence of responses during the interview conducted in the framework of the Project as compared to interview of 1988 is 59%.

Actually the fact of milk consumption disagreed in 10% of cases, meanwhile according to the interview of 1988 in 9% of cases subjects did not drink milk, but according to the data of interview performed in the framework of the Project – they did.

Recurrence of responses during the repeated interview comparing to initial one is 52 %, and the answer "do not remember" during the repeated interview was given in 18% of cases.

V. Date of canceling of milk consumption in April-May 1986

The result of comparison – **similarity**, when:

1. Dates of canceling of milk consumption are similar ±1 day;
2. By the results of both interviews the subject did not consume milk;

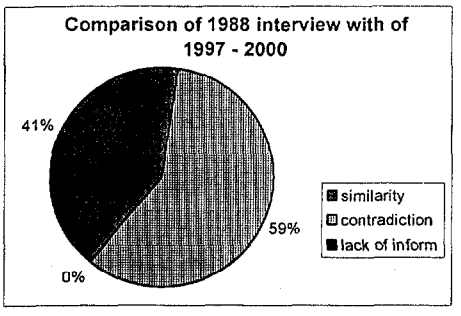
The result of comparison – **converge**, when

1. Dates of canceling of milk consumption varied in more than one day
2. By the results of one interview the subject consumed milk, by the result of another – did not;

The result of comparison – **lack of information**, when:

To the question the answer was "do not remember" at least at one interview;

Diagrams 10 and 10a present the result of comparison for the interview conducted in 1988 and those in the framework of the Project, and initial with repeated accordingly.



Diadram 10.

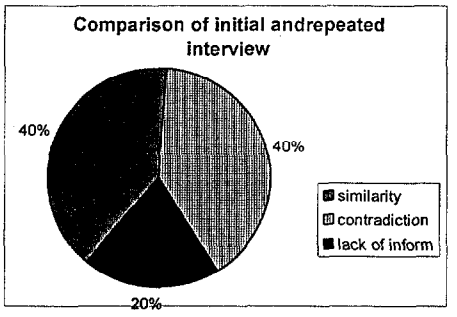


Diagram 10a.

As it is evident from presented diagrams recurrence of responses during the interview conducted in the framework of the Project as compared to interview of 1988 is 41% that is lower than recurrence of responses to the question concerning the date of move out from the contaminated territory (56%).

Recurrence of responses during the repeated interview comparing to initial one is 40 %, that corresponds to recurrence of responses to the question concerning the date of move out from the contaminated territory (39%).

In general if subjects during the period April-May 1986 moved out from the contaminated territory so the date of canceling of milk consumption should correspond to the date of move out (if the subject consumed milk before move out), or it could be less than date of move out (if the subject canceled milk consumption before the day of move out).

In the interview of 1988 in 10 % of cases when the subject moved out from the contaminated territory during the period April-May 1986 the date of canceling of milk consumption is mentioned as 31.05.86. It seemed that information concerning the date of canceling of milk consumption of the Interview 1988 is not completely verified.

Thus, in this question comparison of interview 1988 with interview in the framework of the Project can not give reliable information with respect to the recurrence of the responses.

Furthermore there are the results of comparison of initial and repeated interview through the questions that were not included to the interview of 1988.

VI. Diary products consumption in April-May 1986

The result of comparison – **similarity**, when "yes" response was given in both interviews.

The result of comparison – **converge**, when

In one interview the response was "yes", and in another – 'no'

The result of comparison – **lack of information,** when to the question the answer was "do not remember" at least in one interview;

Diagram 11 presents the results of comparison of initial interview with repeated one.

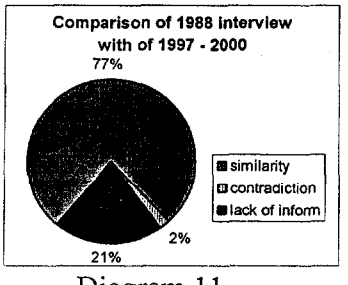


Diagram 11

Recurrence of answers during the repeated interview as compared to initial one is 77%. The answer "do not remember" gave 21% of subjects, the majority of them came to the repeated interview

alone (without parents) and who were younger 10 y.o. at the time of the accident.

VII. Consumption of green leafy vegetables in April-May 1986

The result of comparison – **similarity**, when "yes" response was given in both interviews.

The result of comparison – **converge**, when

In one interview the response was "yes", and in another – 'no'

The result of comparison – **lack of information,** when to the question the answer was "do not remember" at least in one interview;

Diagram 12 presents the results of comparison of initial interview with repeated one.

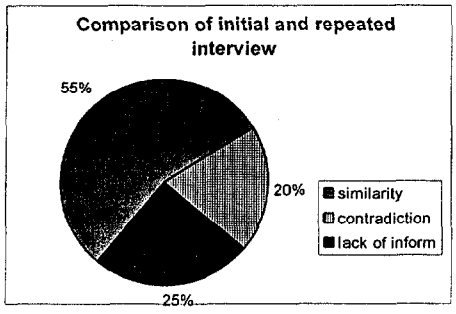


Diagram 12

Recurrence of answers during the repeated interview as compared to initial one is 55%. The answer "do not remember" gave 25% of subjects, the majority of them came to the repeated interview alone (without parents) and who were younger 10 y.o. at the time of the accident.

VIII. Starting date of green leafy vegetables consumption.

The result of comparison – **similarity**, when:

1. The subject started consuming green leafy vegetables before the accident regardless exact date.
2. The subject started consuming green leafy vegetables following the accident and starting dates were similar ±1 day.

The result of comparison – **converge,** when the subject started consuming green leafy vegetables following the accident and starting dates differs for more than one day

The result of comparison – **lack of information,** when to the question the answer was "do not remember" at least in one interview;

Diagram 13 presents the results of comparison of initial interview with repeated one.

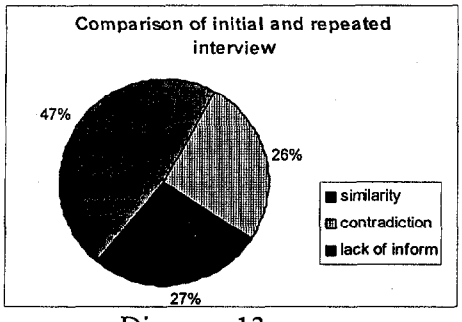


Diagram 13

Recurrence of answers during the repeated interview as compared to initial one is 47%. Participants of the interview can recall the starting date of green leafy vegetables consumption worse than the fact of its consumption.

Conclusion

1. Comparison of information obtained in the interview of 1988 with that performed in the framework of the project 1997-2000 through the questions:
   1. Starting date of cattle pasturing in spring 1986.
   2. Conducting of iodine prophylaxis
   3. Date of canceling of milk consumption in April-May 1986

   Can not give reliable information of the level of recurrence because:
   1. The question of starting date of cattle pasturing in spring 1986 was not included in the majority of questionnaires of 1997-2000.
   2. Information concerning iodine prophylaxis was missed in more than 25% of questionnaires of 1997-2000
   3. Information concerning date of canceling of milk consumption in April-May 1986 was not completely verified.
2. Recurrence of information concerning the date of move out from the contaminated territory in April-May 1986 and average amount of milk consumed per day in interview 1997-2000 as compared to the interview 1988 was 56% and 59% correspondingly. This fact corresponds to the quality estimate "good" (64%)
3. Recurrence of information concerning the date of move out from the contaminated territory in April-May 1986 and average amount of milk consumed per day in repeated interview as compared to initial one is lower than when comparing interview 1997-2000 with interview 1988 (39% and 52% correspondingly). It could be explained first of all by the fact that to the repeated interview 38% less subjects younger 10 y.o. at the time of the accident came without parents than to initial interview. Therefore, quality estimate "good" at the repeated interview was met 36% rarely than at initial interview.
4. Recurrence of responses concerning diary products consumption and green leafy vegetables in April-May 1986 at initial interview as compared to repeated was in the range 55% -75%. The answer "do not remember" was given approximately at 25% of cases, that corresponds to the share of subjects, who were less than 10 y.o at the time of the accident and who came to the repeated interview without parents.

COMPLETE PREPARATION OF UNIQUE BELARUS-UKRAINE SELF-INTERVIEW FORM AND INSTRUCTION FOR INTERVIEWER HOW TO CONDUCT INITIAL INTERVIEW.

Appendix 1 presents a variant of self-interview form agreed with Ukrainian dosimetrists. Instruction for interviewer how to administer the questionnaire-interview while conducting initial interview of the subject and accompanying persons is presented in Appendix 2.

Milestone 28: Calculate I-131 concentration and exposure doses by scenaria for SRP-68-01 and DP-5 instruments to conduct the second stage of comparison of results obtained by Belarus, Ukrainian, and Moscow dosimetry groups.

1. ESTIMATION OF ^{131}I CONCENTRATION IN THYROID.

^{131}I concentration in thyroid $A_a(t_m)$ at the moment of time t_m is calculated by the result of direct measurement of exposure dose rate over thyroid made at the moment of time t_m, in accordance with the following equation:

$$A_a(t_m) = CF_a \cdot [P_{th}(t_m) - P_b(t_m)] \qquad (1.1)$$

when CF_a – calculating factor from the value of exposure dose rate over thyroid to ^{131}I concentration in thyroid depending from subject age and type of instrument used for measurement of exposure dose rate, Bq h μR^{-1};

$P_{th}(t_m)$ – readings of the instrument over subject thyroid caused by ^{131}I concentration in thyroid and by other sources of radiation μR h^{-1};

$P_b(t_m)$ - readings of the instrument caused by other sources of radiation inside, on the surface and outside of the subject, μR h^{-1};

a – age of subject, used as an index for the parameters of equation (1.1), complete years.

By data of 5 scenarios measurement were made by SRP-68-01. Values of calculation factor CF_a for SRP-68-01, corresponding to the reference [1] are presented in the Table 17.

Table17

Age dependence of parameters used for calculation of concentration and dose from I-131 in thyroid

Age, years	Calculation factor SRP-68-01 for ^{131}I, Bq h μR^{-1}	Thyroid weight, kg 10^{-3}	Effective energy of decay, Joul $decay^{-1}$ 10^{-14}	Effective loss constant of ^{131}I from thyroid, day^{-1}
	CF	m	E	λ_{th}
0-1	99.5	1.3	2.70	0.127
1-2	101.8	1.8	2.82	0.120
2-3	103.4	2.3	2.97	0.117
3-4	104.8	2.7	3.02	0.114
4-5	106.6	3.2	3.16	0.111
5-6	109.5	3.9	3.35	0.108
6-7	111.3	4.8	3.51	0.106
7-8	117.8	5.7	3.50	0.103
8-9	122.3	6.6	3.40	0.101
9-10	126.5	7.5	3.29	0.098
10-11	129.9	8.4	3.22	0.096
11-12	132.4	9.3	3.20	0.096
12-13	134.5	10.2	3.22	0.096
13-14	136.4	11.1	3.26	0.096
14-15	138.7	12.0	3.28	0.095
15-16	141.7	13.2	3.33	0.095
16-17	145.5	14.7	3.38	0.095
17-18	150.0	16.2	3.37	0.094

In all the scenarios there are no additional measurements of subjects in the area of stomach. Division of $P_b(t_m)$ value, considering radiation background in the place of subject measurement, surface radioactive contamination of subject and concentration of other radionuclides in the body, into three components modifies equation (1.1) to the following:

$$A_a(t_m) = CF_a \cdot \left[P_{th}(t_m) - K_{sh,a} \cdot P_r(t_m) - P_{s,th}(t_m) - P_{i,th}(t_m)\right] \qquad (1.2)$$

when $P_r(t_m)$ – readings of the instrument in the place of measurement in absence of subject, μR h^{-1};

$K_{sh,a}$ – sizeless correction for considering shield from external γ-radiation from subject's body. The values of correction are taken from reference [2] and is: 1.00 for children younger 14 лет, 0.95 for the age of 14 to 18, 0.90 for adults

$P_{s,th}(t_m)$ - readings of the instrument, caused by surface contamination of subject during measurement over thyroid μR h^{-1};

$P_{i,th}(t_m)$ - readings of the instrument, caused by radionuclides incorporated in subject's body during measurement over thyroid μR h^{-1};

When estimating ^{131}I concentration in thyroid by 5 scenarios it is assumed that there is no surface contamination of the subject by radionuclides, i.e. $P_{s,th}(t_m) = 0$.

Effect of radionuclides incorporated in subject's body while measuring over thyroid to the instrument readings is calculated through the following equation:

$$P_{i,th}(t_m) = \sum_j \frac{A_{j,a}(t_m)}{CF_{j,a}} \qquad (1.3)$$

when $CF_{j,a} - CF_a$ – calculating factor from the value of exposure dose rate over thyroid to j-radionuclide content in subjects body depending from subjects age and type of instrument used for measurement of exposure dose rate, Bq h μR^{-1};

$A_{j,a}$ –j-radionuclide content in subject's body, Bq;

Three cesium radionuclides ^{134}Cs, ^{136}Cs и ^{137}Cs are considered as incorporated radionuclides.

Calibration factors of SRP -68-01 for isotopes ^{134}Cs, ^{136}Cs, ^{137}Cs for subject of *a* age were defined through interpolation by cubic splines of basic values of six ages (0, 1, 5, 10, 15, 20 y.o) according to reference [7]. The results of interpolation for 18 age groups are presented in Table 18.

Table 18

Age dependence of calibration factor of SRP-68-01 for cesium-134, 136, 137

Age, years	Calibration factor of SRP-68-01 for ^{134}Cs, Bq/ μR h^{-1} $^{134}CF\ 10^{-1}$	Calibration factor of SRP-68-01 for ^{136}Cs, Bq/ μR h^{-1} $^{136}CF\ 10^{-1}$	Calibration factor of SRP-68-01 for ^{137}Cs, Bq/ μR h^{-1} $^{137}CF\ 10^{-1}$
0-1	59.7	39.1	152.0
1-2	73.1	48.1	185.0
2-3	82.9	54.9	209.4
3-4	90.4	60.2	227.9
4-5	96.8	64.8	243.9
5-6	103.5	69.4	260.8
6-7	111.2	74.7	280.4
7-8	120.1	80.7	302.9
8-9	130.3	87.6	328.7
9-10	141.8	95.6	358.1
10-11	154.7	104.8	391.1
11-12	168.7	115.1	427.2
12-13	183.3	125.9	464.7
13-14	197.8	136.7	502.2
14-15	211.5	147.1	538.0
15-16	223.9	156.5	570.7
16-17	234.9	164.9	599.9
17-18	244.6	172.4	626.2

^{137}Cs concentration in the human body at the moment of time *t* in accordance with reference [8] is estimated by the following age dependent function

$$Q_{137}(t) = a_a \cdot e^{-\lambda 1 \cdot t} + b_a \cdot e^{-\lambda 2 \cdot t} - c_a \cdot e^{-\lambda 3_a \cdot t} \qquad (1.4)$$

when $Q_{137}(t)$ – concentration in the human body at the moment of time *t* ^{137}Cs, Bq;

a, b, c approximation factor, Bq;

$\lambda_1, \lambda_2, \lambda_3$ – constants of extraction, day^{-1};

$\lambda_1 = 3.18\ 10^{-3}$, $\lambda_2 = -\ 1.1\ 10^{-4}$.

Approximation factors and λ_3 constant for the subject of *a* age was determined through interpolation by cubic splines of basic values of six ages (0, 1, 5, 10, 15, 20 y.o) according to reference [8]. The results of interpolation for 18 age groups are presented in Table 19.

Table 19

Age dependence of parameters in equation (1.4)

Age, years	a, Bq/kBq м$^{-2}$	b, Bq/kBq м$^{-2}$	c, Bq/kBq м$^{-2}$	λ_3, day^{-1}
0-1	28.0	4.5	33.5	0.048
1-2	29.1	5.2	35.2	0.054
2-3	23.7	5.3	29.5	0.051
3-4	19.4	5.1	24.5	0.042
4-5	24.3	4.9	29.2	0.033
5-6	46.2	5.3	51.7	0.025
6-7	84.5	6.1	91.8	0.020
7-8	131.0	7.3	140.7	0.018
8-9	176.7	8.6	188.9	0.017
9-10	212.6	9.6	226.8	0.017
10-11	230.5	10.2	245.9	0.016
11-12	231.3	10.4	246.9	0.015
12-13	225.2	10.4	240.4	0.013
13-14	223.1	10.4	237.6	0.010
14-15	235.9	10.7	250.0	0.008
15-16	273.8	11.5	288.0	0.006
16-17	339.3	12.8	354.1	0.005
17-18	426.7	14.5	442.6	0.005

^{134}Cs concentration in the human body is calculated through ^{137}Cs concentration in accordance with the following equation:

$$Q_{134}(t) = 0.52 \cdot Q_{137}(t) \cdot e^{-(\lambda_{134}-\lambda_{137})t}, \qquad (1.5)$$

when $Q_{134}(t)$ – concentration in the human body at the moment of time t ^{134}Cs, Bq;
0.52 – ratio between ^{134}Cs and ^{137}Cs at the moment of fall out;
$\lambda_{134} = 9.21\ 10^{-4}$ and $\lambda_{137} = 6.29\ 10^{-5}$ – constants of radioactive decay of ^{134}Cs and ^{137}Cs, accordingly, day^{-1};
^{136}Cs concentration in the human body is calculated through ^{137}Cs concentration in accordance with the following equation:

$$Q_{136}(t) = 0.28 \cdot Q_{137}(t) \cdot e^{-(\lambda_{136}-\lambda_{137})t}, \qquad (1.6)$$

when $Q_{136}(t)$ – concentration in the human body at the moment of time t ^{136}Cs, Bq;
0.28 - ratio between ^{136}Cs and ^{137}Cs at the moment of fall out;

$\lambda_{136} = 0.074$ - constants of radioactive decay of ^{136}Cs, day^{-1};

For 2 from 5 subjects information on radiation background in the place of measurement is missed. Radiation background at the date of measurement is calculated using Mathcad 6.0. Assumed radionuclide content of fallout with respect to ^{137}Cs for calculation of radiation background was taken from reference [8], and corresponds to the central spot and presented in Table 20.

Table 20

Radionuclide content of fallout.

Nuclide	Central spot
^{137}Cs	1
^{134}Cs	0.52
^{103}Ru	5.2
^{106}Ru	2
^{95}Zr	3.3
^{99}Mo	3.2
^{131}I	18
^{132}Te	27
^{140}Ba	3.8
^{141}Ce	3.9
^{144}Ce	2
^{136}Cs	0.28
^{125}Sb	0.02
^{239}Np	5
^{135}I	0.2
^{133}I	6.2

Calculated radiation background at the date of measurement for virgin lands is 1086 μR^{-1} h for subject 2 and 624 μR^{-1} h for subject 4. Transfer to the territory of settlement is conducted with reducing factor 0.7. Protective factor is equal to: for wooden building - 2, for brick stone building – 10.

Results of estimation of ^{131}I concentration in thyroid, calculated by equation (1.2) considering equations (1.3 – 1.6) and estimation of missed radiation background are presented in Table 21.

Table 21

Calculated concentration of ^{131}I in thyroid using the data of 5 scenarios.

Subject	1	2	3	4	5
Thyroid activity, kBq	119	86 – wooden building 115 – brick stone building	19	232 – wooden building 254 - brick stone building	167

2. Calculation of internal thyroid dose according to the data of direct measurements.

Thyroid internal dose from ^{131}I radioisotope for the period of time ΔT in general is determined by the following equation:

$$D_a = \frac{E_a}{m_a} \cdot Q_a, \qquad (2.1)$$

when D_a – thyroid exposure dose for the period of time ΔT, Gy;

E_a - ^{131}I effective energy of decay, J decay^{-1};

m_a – thyroid weight, kg;

Q_a – number of ^{131}I decays in thyroid of subject for the period of timeΔT, decay;

a – subject's age, used as an index for parameters of equation (2.1), complete years.

Age dependent E_a and m_a, corresponding to reference [1], are presented in Table 1.

Number of ^{131}I decays in thyroid is estimated by ^{131}I concentration in thyroid. Quantitative characteristic describing ^{131}I concentration in thyroid at the moment of time t, is ^{131}I activity in thyroid. In general number of ^{131}I decays in thyroid for the period of time ΔT is estimated as integral of activity of ^{131}I in thyroid for the period of time ΔT:

$$Q_a = \int_0^{\Delta T} A_a(t)dt \qquad (2.2)$$

when $A_a(t)$ – ^{131}I activity in thyroid at the moment of time t, Bq;
t – Integration variable, reflecting time period, for which number of ^{131}I decays in thyroid is calculated, s.

^{131}I activity in thyroid in the moment of time t is estimated by ingress and retention of ^{131}I in thyroid before the moment of time t from the equation:

$$A_a(t) = A_0 \cdot \int_0^t IFm_a(\tau) \cdot RF_a(t-\tau)d\tau, \qquad (2.3)$$

when $IFm_a(\tau$ –function, describing ^{131}I ingress into thyroid under used model, Bq s^{-1};
$RF_a(t - \tau)$ – Function of retention of ^{131}I from thyroid;
t – period of time from the moment of ^{131}I fall out in the place of subject residence, s;
τ - Integration variable, reflecting time period of ^{131}I ingress, s.
A_0 – normalization factor between ^{131}I concentration, actually existing in thyroid at the moment of time t, and ^{131}I concentration, existing in thyroid at the moment of time t according to models.

To estimate this normalization factor by the data of direct measurements of exposure dose rate over thyroid is possible using the following equation:

$$A_0 = \frac{A_a(t_m)}{\int_0^{t_m} IFm_a(\tau) \cdot RF_a(t_m - \tau)d\tau} = \frac{CF_a \cdot [P_{th}(t_m) - P_b(t_m)]}{\int_0^{t_m} IFm_a(\tau) \cdot RF_a(t_m - \tau)d\tau}, \qquad (2.4)$$

when CF_a – calculating factor from the value of exposure dose rate measured by the instrument to ^{131}I activity in thyroid, Bq h μR^{-1};
$P_{th}(t_m)$ – instrument reading over thyroid, μR h^{-1};
$P_b(t_m)$ - "background" instrument readings, μR h^{-1}.

Introducing equations (2.2 – 2.4) to equation (2.1), we receive:

$$D_a = \frac{E_a}{m_a} \cdot CF_a \cdot [P_{th}(t_m) - P_b(t_m)] \cdot \frac{\int_0^{\Delta T} \int_0^t IFm_a(\tau) \cdot RF_a(t-\tau)d\tau dt}{\int_0^{t_m} IFm_a(\tau) \cdot RF_a(t_m - \tau)d\tau} \qquad (2.5)$$

Function of ^{131}I retention in thyroid as assumed as unique for all the subjects of one age group and is calculated by the following equation:

$$RF_a(t) = e^{-\lambda_{tha} \cdot t} \qquad (2.6)$$

When λ_{tha} – constant of effective extraction of ^{131}I from thyroid: values for *a age*, are taken from reference [1], presented in Table 19, day^{-1};

In accordance with the data of 5 scenarios, ^{131}I ingress into thyroid could be done the following way:

- Inhalation ingress;
- Ingress with cow's milk;
- Ingress with green leafy vegetables

For 2 subjects ingress of radioiodine to the body varied because of iodine prophylaxis: intake of stable iodine. In order to consider iodine prophylaxis function of ^{131}I ingress into thyroid should be transformed to the following equation:

$$IFm_a(t) = (IF_{ma}(t) + IF_{va}(t) + IF_{ia}(t)) \cdot BF(t), \qquad (2.7)$$

when $IF_{ma}(t)$ – function, describing ^{131}I ingress into thyroid with cow milk, Bq s^{-1};
$IF_{va}(t)$ – function, describing ^{131}I ingress into thyroid with green leafy vegetables, Bq s^{-1};
$IF_{ia}(t)$ – function, describing ^{131}I ingress into thyroid through inhalation, Bq s^{-1};
$BF(t)$ – function of ^{131}I ingress blocking in thyroid at the cost of iodine prophylaxis.

Function of ^{131}I ingress blocking in thyroid at the cost of iodine prophylaxis $BF(t)$ is calculated as Crockener delta-function of the following type:

$$BF(t) = \begin{Bmatrix} 0 \; t_b \le t \le t_e) \\ 1 t < t_b, t_e < t) \end{Bmatrix}, \qquad (2.8)$$

when t_b – time interval between starting date of iodine prophylaxis and starting date of ^{131}I fall out on the territory of subject residence, day;
t_e – time interval between end date of iodine prophylaxis and starting date of ^{131}I fall out on the territory of subject residence plus one day, day;

Let us look through each way of ^{131}I ingress into thyroid, considered in the model of thyroid internal dose calculation through 5 scenarios separately. As a dose interval used in the model days are considered

2.1. Inhalation ingress of ^{131}I into thyroid.

Inhalation ingress of ^{131}I into thyroid is estimated the following way:

$$IF_{ia}(t) = Kl \cdot Kb \cdot Ksh \cdot C_i(t) \cdot V_{ia}(t), \qquad (2.9)$$

When $IF_{ia}(t)$ – amount of ^{131}I, ingressed into thyroid of a subject of a age through inhalation at the moment of time t, Bq day^{-1};
$C_i(t)$ - ^{131}I concentration in air at the moment of time t, Bq m^{-3};
$V_{ia}(t)$ – amount of air, consumed by human of a age at the moment of time t, m^3 day^{-1};
Kl – ^{131}I transfer factor from air to blood, $Kl = 0.7$;
Kb – ^{131}I transfer factor from blood to thyroid, $Kb = 0.3$;
Ksh – factor, considering reduction of radionuclide concentration inside building to concentration outdoor $Ksh = 0.7$;
^{131}I concentration at the moment of time t was estimated using the following equation:

$$C_i(t) = \frac{Ar(t)}{V_0}, \qquad (2.10)$$

when $V_0 = v_0 \cdot 24$, m day^{-1};
v_0 – effective rate of ^{131}I deposition from radioactive cloud to the surface of soil and grass, m h^{-1};
$v_0 = 14 \pm 11$ m h^{-1} (95% interval) when «dry» deposition [2];
$v_0 = 110 \pm 70$ м ч$^{-1}$ (95%-interval) when wet deposition [2];
$Ar(t)$ –amount of ^{131}I, deposited to soil and grass at the moment of time t, kBq m^{-2} day^{-1}.

Effective rate of ^{131}I deposition from radioactive cloud to soil and grass was calculated considering the following ratios between different chemical types of ^{131}I in depositions for the conditions of Belarus: aerosol – 50 %, gas – 25 % of elementary iodine and 25 % of organic iodine. Using values of rates for different types of ^{131}I deposition to soil, accepted in ECOSYS-87, effective rate of ^{131}I deposition to soil is equal to:

$$v_0 = 0.5 \cdot 0.5 + 0.25 \cdot 3 + 0.25 \cdot 0.05 = 1.0125, \text{ mm sec}^{-1} = 3.6 \text{ m h}^{-1} \qquad (2.11)$$

Amount of respirable air at the moment of time t, is assumed constant for the subject of a age and was estimated through interpolation of basic values of 5 ages (1 year, 5 y.o, 10 y.o, 15 y.o and 20 y.o) by cubic splines in accordance with reference [4]. Results of interpolation for 18 age groups are presented in Table 22.

Table 22

Amount of air respirable by subject of *a* age

Age, years		Rate of breathing, $m^3 h^{-1}$
From 0	To 1	
0	1	0.15
1	2	0.21
2	3	0.28
3	4	0.34
4	5	0.40
5	6	0.44
6	7	0.48
7	8	0.51
8	9	0.54
9	10	0.58
10	11	0.62
11	12	0.68
12	13	0.74
13	14	0.80
14	15	0.87
15	16	0.93
16	17	0.99
17	18	1.05

Estimation of ^{131}I ingress into thyroid through inhalation is made only for time of radioactive cloud passing the territory of subject's residence. Resuspension of deposited ^{131}I in estimation of ^{131}I ingress into thyroid through inhalation was not considered.

2.2. ^{131}I ingress into thyroid with green leafy vegetables

Ingress of ^{131}I into thyroid through green leafy vegetables in general is described by the following equation:

$$IF_{va}(t) = K_b \cdot K_{po} \cdot C_v(t) \cdot V_{va}(t), \qquad (2.12)$$

when $IF_{va}(t)$ – amount of ^{131}I, ingressed into thyroid of subject of a age through green leafy vegetables at the moment of time t, Bq day^{-1};

K_{po} –transfer factor of ^{131}I, ingressed per oral to the blood, $K_{po} = 1$;

$C_v(t)$–^{131}I concentration in green leafy vegetables at moment of time t, Bq kg^{-1};

$V_{va}(t)$ – amount of green leafy vegetables consumed by subject of a age at the moment of time t, kg day^{-1}.

^{131}I concentration in green leafy vegetables at the moment of time t is estimated both through direct contamination of leafy surface by deposition from passing by radioactive cloud or as a result of resuspension as well as through thransfer of ^{131}I from soil to green leafy vegetables through roots

$$C_v(t) = C_{vl}(t) + C_{vr}(t), \qquad (2.13)$$

when $C_{vl}(t)$ ^{131}I concentration in green leafy vegetables at the moment of time t caused by leafy contamination, Bq kg^{-1};

$C_{vr}(t)$ – ^{131}I concentration in green leafy vegetables at the moment of time t caused by root contamination, Bq kg^{-1};

While estimating thyroid dose root contamination of green leafy vegetables and resuspension were not taken into consideration.

^{131}I concentration in green leafy vegetables caused by leafy surface contamination was assumed directly proportional to amount of ^{131}I deposition to leafy surface and loses of activity caused by winding out, radioactive decay and growing reducing.. ^{131}I concentration in ready in prepared green leafy vegetables at themoment of time t caused by direct contamination of leafy surface of green vegetables is described by the following equation:

$$C_{vl}(t) = \int_0^t \frac{f_{wv}(\tau)}{Y_v(\tau)} \cdot Ar(\tau) \cdot \exp(-(\lambda_{wd} + \lambda_r)(t-\tau)d\tau, \qquad (2.14)$$

when $Ar(\tau)$ – amount of ^{131}I, deposited to the surface of soil and green leafy vegetables at the moment of time t, Bq m^{-2} day^{-1};

$f_{wv}(\tau)$ – initial retention of ^{131}I by green leafy vegetables, relative units., while calculating doses it is assumed constant $f_{wv}(\tau) = 0.25$;

$Y_v(\tau)$ – productivity of green leafy vegetables, kg m^{-2}, while calculating dose through 5 scenarios it is assumed constant: $Y_v(\tau) = 2.0$;

2.3. Ingress of ^{131}I into thyroid through cow milk.

Ingress of ^{131}I into thyroid through in general is determined by the following equation:

$$IF_{ma}(t) = K_b \cdot K_{po} \cdot C_m(t) \cdot V_{ma}(t), \qquad (2.15)$$

when $IF_{ma}(t)$ – amount of ^{131}I, ingressed into thyroid of the subject of a age through cow milk at the moment of time t, Bq day^{-1};

$C_m(t)$ – ^{131}I concentration in cow milk, Bq l^{-1};

$V_{ma}(t)$ – amount of consuming milk by subject of a age, l day^{-1}.

It is assumed that ingress of ^{131}I into cow milk is occurred only through food chain of ingress. As a food only fresh grass eaten by a cow on a pasture was considered. Amount of ^{131}I ingressed to cow's body at the moment of time t depend from the amount of feed and its contamination and is described bby the following equation:

$$A_g(t) = C_g(t) \cdot I_g(t), \qquad (2.16)$$

when $A_g(t)$ – amount of ^{131}I, ingressed to cow's body through fresh grass from pasture at the moment of time t, Bq day^{-1};

$C_g(t)$ – ^{131}I concentration in fresh grass from pasture, Bq kg^{-1};

$I_g(t)$ – amount of fresh grass from pasture, eaten by cow, kg day^{-1}. While calculating doses it is considered constant for cow – 40 kg day^{-1}.

It is assumed that ^{131}I concentration in fresh grass from pasture in case of multiple fall outs is described by the following equation:

$$C_g(t) = \int_0^t \frac{f_w(\tau)}{Y(\tau)} \cdot Ar(\tau) \cdot \exp(-(\lambda_{wd} + \lambda_r)(t-\tau)d\tau, \qquad (2.17)$$

when $Ar(\tau)$ – amount of ^{131}I, fallen down to surface of soil and grass at the moment of time t, Bq м$^{-2}$ day^{-1};

$f_w(\tau)$ – initial retardation of ^{131}I by grass, relative units., while calculating doses is assumed as constant $f_w(\tau) = 0.27$;

$Y(\tau)$ – productivity of fresh pasture grass, kg м$^{-2}$, while calculating doses is assumed as constant: $Y = 0.5$ кг м$^{-2}$;

$\lambda_{wd} = 0.064$ – effective rate of grass decontamination from radionuclides at the cost of winding out and grass growing, day $^{-1}$.

Transfer of ^{131}I from fresh pasture grass to cow's milk is determined by the following equation:

$$C_m(t) = TF_m \cdot \int_0^t A_g(\tau) \cdot \lambda_b \cdot \exp(-(\lambda_b + \lambda_r) \cdot (t - \tau)) d\tau, \qquad (2.18)$$

when TF_m – transfer factor of ^{131}I from grass to milk, day l^{-1}, for cow's milk $TF_m = 3\ 10^{-3}$;

$\lambda_b = 0.54$ – effective rate of milk decontamination ^{131}I an the cost of biological decontamination, day^{-1}.

In accordance with equation (2.16 – 2.18) and assumed admission per-oral ingress of ^{131}I through contaminated cow's milk is described by the following way:

$$IF_{ma}(t) = TF_m \cdot \lambda_b \cdot \int_0^t A_g(\tau) \cdot \exp(-(\lambda_b + \lambda_r) \cdot (t - \tau)) d\tau \cdot V_{ma}(t), \qquad (2.19)$$

In case of single fall out the equation is:

$$C_m(t) = const \cdot \int_0^t e^{-\lambda_c \cdot (t-\tau)} \cdot e^{-\lambda_g \tau} d\tau \qquad (2.20)$$

when $\lambda_c = \lambda_b + \lambda_r$, - effective rate of milk decontamination from radionuclide at the cost of biological decontamination (*b index*), and at the cost of radioactive decay, λ_c=0.63 day^{-1};

$\lambda_g = \lambda_{wd} + \lambda_r$ - effective rate of grass decontamination at the cost of winding out and grass growing (*wd index*), and at the cost of radioactice decay, λ_g=0.15, day^{-1}.

Considering equation (2.20), function ^{131}I ingress through cow's milk could be derived to the following:

$$IF_{ma}(t) = const \cdot V_{ma}(t) \cdot (e^{-\lambda_g \cdot t} - e^{-\lambda_b t}) \qquad (2.21)$$

2.4. Outcomes of dose calculation through 5 scenarios

Calculation of thyroid doses was done using Mathcad 6.0 program and equations described above via method of figural integration.

As intermediate step of dose calculation there was estimated ^{131}I concentration in thyroid at the moment of direct measurement of exposure dose rate over thyroid for each model function of ingress considering assumed admissions. Outcomes of calculation through the data of 5 scenarios are presented in Table 23.

Table 23

Concentration of ^{131}I in thyroid at the date of measurement calculated through the data of 5 scenarios for 3 model ways of ingress

Subject	Ai, kBq	Av, kBq	Am, kBq	A, kBq
1	1.5	12.0	202.8	216.3
2	1.0	0	51.2	52.2
3	0.4	0	23.8	24.2
4	2.7	22.0	480.9	505.6
5	1.9	18.8	182.5	203.2

Thyroid dose calculation is made for all available in 5 scenarios ways of ingress of ^{131}I into thyroid. The results are presented in Table 24.

Table 24

Thyroid dose estimate for 5 scenarios.

Subject	Thyroid dose, mGy
1	2584
2	1258
3	1841
4	506
5	1025

3. Uncertainty of pointwise estimates of ^{131}I concentration in thyroid and thyroid dose.

Calculation of Uncertainty of pointwise estimates of ^{131}I concentration in thyroid and thyroid dose was done using Monte-Carlo method. According to Monte-Carlo method for each parameter used in estimation of ^{131}I concentration in thyroid and thyroid dose considering known or assumed function of density of probability parameter some value is generated. Using a set of obtained at random parameters ^{131}I concentration or thyroid dose is estimated. Repeating such procedure N times we receive a distribution of N values ^{131}I concentration in thyroid or thyroid dose

To calculate uncertainty for 5 scenarios using Monte-Carlo method Mathcad 6.0 program was applied. Procedure of generation of random set of values was conducted 1000 times.

3.1. Uncertainty of estimate of ^{131}I concentration in thyroid.

^{131}I concentration in thyroid is estimated by equation (1.2). The following assumptions and admissions were used.

According to technical description of SRP –68-01 instrument its readings have normal distribution. Values of exposure dose rate presented in scenarios are taken as average arithmetic values of the results of measurements. Standard deviation from mean value taken from the data of technical description of SRP -68-01, is 6% from measured value.

For CF_a calculating factor a triangle distribution was chosen. As mode of distribution a calculating factor corresponding to the age of subject according to Table 1 is taken. As a minimal value calculating factor corresponding to the age of subject minus one year is taken. As a maximal value calculating factor corresponding to the age of subject plus one year is taken.

For sizeless coefficient $K_{sh,a}$ a triangle distribution is assumed.

While calculating radiation background at the place of measurement it is assumed that distribution of radiation background is log-normal with GSD = 2.06.

Characteristics of function of probability density for the parameters of the equation (1.3) are presented in the Table 25.

Table 25

Characteristics of parameters assumed for calculation of uncertainty of ^{131}I concentration in thyroid.

Parameter	Type of distribution	x_{av} or mode	σ	X_{min}	x_{max}
CF_a	Triangle	CF_a		CF_{a-1}	CF_{a+1}
$P_{th}(t_m)$	Normal	P_{av}	0.06* P_{av}		
$P_r(t_m)$	Normal	P_{av}	0.06* P_{av}		
K_{ab}	Triangle	0.88		0.76	1.00
$K_{sh,a}$	Triangle	1.0 (<14 y.o) 0.95 (14-18 y.o)		0.95 0.90	1.00 1.00

Results of Monte-Carlo method application for estimation of ^{131}I concentration in thyroid through 5 scenarios are presented in Table 26.

Table 26

Estimate of ^{131}I concentration in thyroid and СГО.

Subject	$A_{50}(t_m)$, kBq	СГО
1	118.1	1.21
2	86 – wooden building 115 – brick building	2.07
3	18.6	1.27
4	232 - – wooden building 254 – brick building	2.07
5	166.2	1.19

3.2. Uncertainty of thyroid dose estimate.

. Uncertainty of thyroid dose estimate was calculated for all routes of ^{131}I ingress into thyroid.

Type of distribution and characteristics of function of probability density for parameters used in calculation of thyroid dose uncertainty are presented in Table 27. Probability characteristics of a ppart of parameters corresponds to the reference [6].

Table 27

Characteristics of parameters, assumed for calculation of thyroid dose uncertainty

Parameter	Type of distribution	x_{av} orr x_{50} or mode	σ or β	x_{min}	x_{max}
$Ar(t)$ – Intensiveness of ^{131}I fall outs for time t, kBq м$^{-2}$ day^{-1}	constant				
f_w – initial retardation of ^{131}I by grass, relative units.	Lognormal	0.27	2.5		
Y – productivity of fresh pasture grass, kg m^{-2}	Even	0.5		0.3	0.8
$I_g(t)$ – average daily grass consumption by cow, kg day^{-1}.	Even	40		30	50
$I_g(t)$ – average daily grass consumption by goat, kg day^{-1}.	Even	13		9	17

$TF_{m,c}$ – Transfer factor of ^{131}I from grass to cow's milk, day l^{-1},	Lognormal	$3.0\ 10^{-3}$	2.1		
λ_b – constant of milk decontamination from ^{131}I at the cost of biological extraction, day^{-1}	Triangle	0.54		0.45	0.65
λ_{w+d} – constant of grass decontamination from ^{131}I at the cost of winding out and growth, day^{-1}	Normal	0.064	0.016		
λ_{tha} – constant of ^{131}I extraction from thyroid, day^{-1}	Triangle	λ_{tha}		λ_{tha-1}	λ_{tha+1}
Kl – Transfer factor of ^{131}I from air to blood, relative units.	Constant	0.7			
Kb – Transfer factor of ^{131}I from blood to thyroid, relative units.	Constant	0.3			
Ksh – factor of ^{131}I concentration attenuation inside building, relative units.	Constant	0.7			
V_{ia} – breathing rate, (m^3 day^{-1})	Triangle	V_{ia}		V_{ia-1}	V_{ia+1}
m_a – thyroid weight , kg	Triangle	m_a		m_{a-1}	m_{a+1}
E_a – effective energy of ^{131}I decay, J $decay^{-1}$	Triangle	E_a		E_{a-1}	E_{a+1}
$V_{ma}(t)$ – consumption of cow or goat milk, l day^{-1}	Constant				
$V_{va}(t)$ – consumption of green leafy vegetables, l day^{-1}	Constant				
A – activity in thyroid, kBq	Correspond to distribution of activity				

Outcomes of uncertainty estimate for thyroid doses are presented in Table 28

Table 28

Median value of thyroid doses and СГО.

Subject	D_{50}, mGy	СГО
1	2580	1.22
2	1251	2.07
3	1834	1.33
4	499	2.07
5	1022	1.23

Milestone 29: **Continue creation of administrative-territorial reference book (including software for data entry and updating in reference book). Provide entry of additional information to the DB of direct measurements of thyroid dose for Mogilev oblast.**

Continue creation of administrative-territorial reference book (including software for data entry and updating in reference book).

As it was described in /9/, administrative territorial reference book of the Republic of Belarus contains information of administrative and territorial division of the Republic till the level of selsoviet and of the settlement (name, type, administrative possessiveness, status). Status of a settlement reflects current actual situation (if the settlement exists, closed, amalgamated to, attached to, change in administrative subordination). It is possible to trace the history of changes in status of the settlement since 1986. All the information concerning changes of administrative and territorial division of the Republic of Belarus were received from the Cabinet of Ministers, Republic of Belarus, and the Ministry of Statistics and Analysis, Republic of Belarus./11–17/.

In DBMS Access 97 by means of VBA there were worked out forms of entry and updating of information to the tables "Administrative subordination" and "Settlements". The forms allow to make new records in tables of DB referred to newly set administrative units and settlements. Meanwhile the codes of administrative subordination and the codes of settlements are assigned automatically. Forms of data updating allow to introduce necessary changes to the records of the tables reflecting changes in the status of a settlement. Information for setting of criteria for searching is chosen from the lists, the codes of administrative subordination and the settlement are created automatically considering the nature of changing of settlement status (instructions for coding are presented in /9/).

Furthermore it is suggested to create forms of reviewing and printing of the history of selected settlement or group of settlements.

PROVIDE ENTRY OF ADDITIONAL INFORMATION TO THE DB OF DIRECT MEASUREMENTS OF THYROID DOSE IN MAY-JUNE 1986.

For each subject to which information was entered earlier to the DB, it is necessary to enter the following data:

1. Reference number of log.
2. Results of measurements of exposure dose rate over thyroid without substraction of background.
3. Units of measurements.
4. Results of measurement of exposure dose rate over the liver.
5. Results of background measurement inside building.
6. Results of background measurement outdoor.
7. Information of the beginning of iodine prophylaxis and its duration.
8. Date of arrival to the place of measurement.
9. Date of moving out from the place of residence.
10. Date of birth.
11. Notes.

Acceptable initial materials (totally 72 logs) were sorted out in accordance with the requirements of data indexing 10/. Encoding of logs was done for all acceptible initial material (about 14,000 individuals).

To introduce additional information to the dosimetry DB in the media of DBMS Access 2 two entry forms have been created. Using one of them it is possible to trace the subject in the data base by the following criteria:

1. Address (Raion, Settlement).
2. Last name, initials.
3. Date of birth.

Furthermore for located subject additional information is entered to the DB. As far as data are entered on out dated PC (processor 80386, 5Mb operation memory, hard disk 330 Mb), searching even in the small files (for example, file of Krasnopolie raion contains 3 000 records) is very slow. Operation with this form appeared to be not very efficient even when the table of DB was divided into the files of separate raions. That is why, an entry form was created using which all information from the initial materials

including passport information, subject's address at the moment of the accident is entered to the blank table. Later on these data ate included to dosimetry DB.

Milestone 30: Calculate age-dependent calibration factors for SRP-68-01 collimator detector. Design software for modeling of effect from contamination of the body and clothes to the results of thyroid radiometry

The task of calculation via Monte-Carlo method of age-dependent calibration factors for SRP –68-01 while measuring by collimator detectors was added to the plan of the second quarter.

The calculations were done for the following conditions:

1) Distance "neck-detector" – 5 and 7 cm;
2) Collimator – cylinder lead tube of 1 cm thick;
3) Lower boarder of discrimination corresponds to the energy of γ-quantums E=0.03 МэВ;
4) Six variants of thyroid corresponding to the standard ages – 0, 1, 5, 10, 15 and 20 years of age;
5) Source – ^{131}I in thyroid;
6) Simplified mathematics phantom was used (neck with inside spine, thyroid, trachea)

The results of calculations are presented in the Table 29 below. Statistic error of the results presented in the Table 29 is not significant and does not exceed 1.5% (for the value of confidence probability P=0.68). But it should be noted that opposite the case when open (without a screen) detector the effect of collimator is expressed in increasing of relative share of soft γ-quantums. As a result more significant effect to the readings of transducer is expressed by the value of low threshold of discrimination which is used in calculations. To estimate the value of this additional error that could be introduced to the value of calibration factor, the calculations have been made for the levels of discrimination of 0.02 and 0.04 МэВ, corresponding to manufacturer's limits of discrimination threshold.

Table 29

Values of calibration factor for SRP-68-01 radiometer with collimated detector for various distances "neck-detector", мкCi h / мR

Age, y.o	Distance "neck-detector"	
	5 cm	7 cm
0	11.6	17.5
1	11.7	17.7
5	12.3	18.4
10	13.5	20.1
15	14.7	21.3
20	15.4	22.2

Figure below shows calibration factors from the Table 29. There are also mentioned values of errors including statistical error of calculation for P=0.95, as well as errors corresponding to changes of low threshold of discrimination ±10 кэВ from the standard value of 30 кэВ. As it is evident from the Fig. 13 the values of errors are relatively small and does not exceed 5 %.

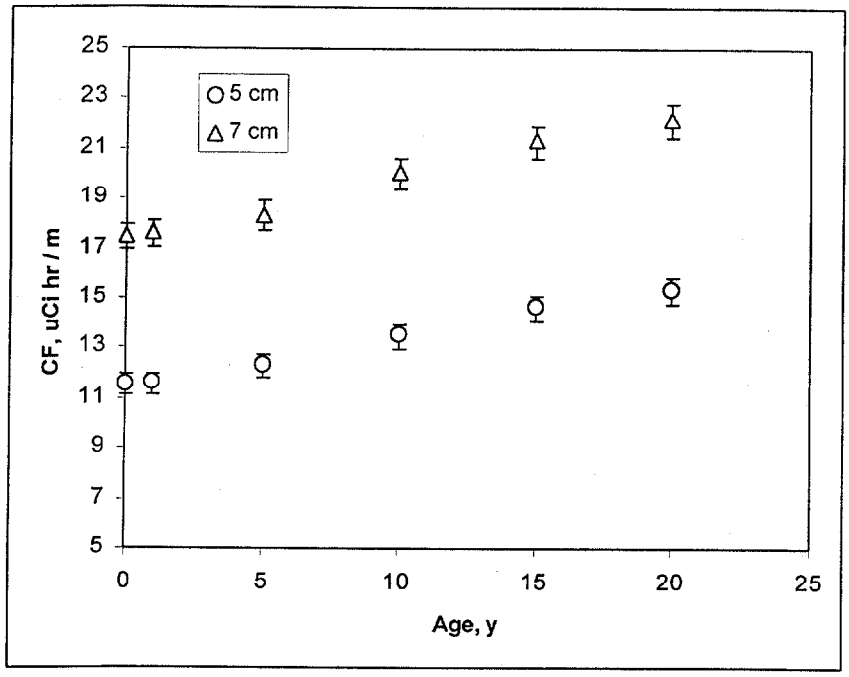


Fig.13 Values of calibration factor for SRP-68-01 radiometer with lead collimated detector when measuring ^{131}I in thyroid of people of different age for two distances "neck-detector"

Besides calculations results of which are presented above the work was continued on modeling the response of instrument to surface radioactive contamination of the human body and the clothes. As it was shown in the previous report (see report of the 1-st quarter 2000), for modeling surface radioactive sources it is necessary to design and work out special subprogram SOURCE, as far as standard means of the used program MCNP4 does not allow to implement cases of distribution of radioactive contamination, which are of practical interest for reconstruction and revision of thyroid doses. Possibility of introducing of non-standard sources is envisaged by the authors of the program MCNP4 through the mechanism, so called external subprogram of the source (user-supplied subroutine). Using algorithm described in the last report such program has been worked out and now it is in the test run.

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Dosimetry self-administer interview

As far as the majority of questions refers to the period April-May 1986 it will be reasonable your parents or relatives who lived with you that time assist answering the questions.

Date of questionnaire Day ☐☐ month ☐☐ year ☐☐☐☐

Put in the check box who assist you answering the question: ❑ Mother ❑ Father ❑ sister, brother ❑ Grandmother ❑ other relatives

---

1. Surname (complete):

2. Name(complete):

1. Ваша фамилия?

3. Patronymic (complete):

4. Surname at the time of the accident (was it different that time)

5. date of birth day ☐☐ month ☐☐ year ☐☐☐☐

6. Address at the time of the accident:

Raion: Selsoviet:

Settlement:

Street: Bld: Appt:

7. **Did you move from the place of residence in the period of** 26 April - 30 June 1986 **for mor than a day (including week ends and holidays):**

❑ **yes** ❑ **no** (shift to question 8)

7a. **Put into the table all the places where you moved to for the period of more than one day during** 26 April - 30 June 1986 **and for how long (at least approximately, dates of arrival and departure)**

Where to			Date (day, месяц)	
Oblast	Raion	Settlement	Date of arrival	Date of departure
			from___/___1986	to___/___1986.
			from___/___1986	to___/___1986.
			from___/___1986	to___/___1986.
			from___/___1986	to___/___1986.
			from___/___1986 г.	to___/___1986.

8. Put into the table all the movements from the place of residence for the period of more than 6 month as well as changes of places of residence starting July 1986 up till now

Where to			arrival (month, year)	Period of staying (months)
oblast	raion	settlement		
			___/___г.	___мес.
			___/___г.	___мес.
			___/___г.	___мес.
			___/___г.	___мес.

9. Were you given some medications because of Chernobyl accident in **April-May 1986.**:

❑ yes ❑ no (shift to question 10)

9а. Who gave you that medications :

❑ Medical staff in polyclinic, hospital

❑ Medical staff, visiting school (kindergarten) or home

❑ Parents at home

9б. Did you take that medications: ❑ yes ❑ no (shift to question 10)

9в. What kind of medication were them: ❑ pills or powder, containing iodine

❑ iodine solution with water or milk

❑ do not know, whether they contained iodine

9г. In the calendar for **April-May 1986**, mark the days (at least approximately) of iodine medication intake:

calendar for April-May 1986

пн	Вт	ср	чт	Пт	сб	вс
					26	**27**
28	29	30	**1**	**2**	**3**	**4**
5	6	7	8	**9**	**10**	**11**
12	13	14	15	16	**17**	**18**
19	20	21	22	23	**24**	**25**
26	27	28	29	30	**31**	

Week ends and holydays. 4, 5 May - Orthodox Easter are marked in bold

10. Did you drink milk in 1986 before the accident:

❑ **yes** ❑ **no (shift to question 11)**

10a. Complete the table. In the field "Source of milk" put in what milk did you drink. In the field "How often did you drink milk?" put one of suggested variants. In the field "What amount of milk did you drink" chose one of suggested variants or put another amount of milk you drank per day.

Source of milk	How often did you drink milk			What amount of milk did you drink per day				
	Every day	Several times a week	Once a week and less	0.25 l	0.5 l	0.75 l	1 l	Another amount (l/day)
❑ Frome the store	❑	❑	❑	❑	❑	❑	❑	
❑ From private cow	❑	❑	❑	❑	❑	❑	❑	
❑ Goat milk	❑	❑	❑	❑	❑	❑	❑	
❑ Dried, children nourishment	❑	❑	❑	❑	❑	❑	❑	
❑ Breast milk	❑	❑	❑	❑	❑	❑	❑	

10б. Did you change milk consumption following the accident **in April-May 1986:** because of movements, using of milk substitutes, using imported milk, refusal from drinking fresh milk:

❑ yes ❑ no (shift to question 11)

10в. Put the date (at least approximately), when did you change milk If you continued drinking milk put in the source and how often per day.

(source of milk: **from the state store, cow's milk from private farm, goat milk, dried milk (children nourishment), breast milk)**

Changes in milk consumption (day, month	Source of milk	How often did you take milk				What amount of milk did you drink per day				
		Did not drink at all	Every day	Several times a week	Once a week and less	0.25 l	0.5 l	0.75 l	1 l	Other amount (l/day)
____/____		❑	❑	❑	❑	❑	❑	❑	❑	
____/____		❑	❑	❑	❑	❑	❑	❑	❑	
____/____		❑	❑	❑	❑	❑	❑	❑	❑	
____/____		❑	❑	❑	❑	❑	❑	❑	❑	
____/____		❑	❑	❑	❑	❑	❑	❑	❑	

10г. When did cattle pasturing started in 1986: ______/______86

11. Did you eat green leafy vegetables in **April-May 1986** (parsley, dill, lettuce, sorrel, spring onions):

❑ yes ❑ no

11a. In what way did you eat green leafy vegetables.

meals or condiments, containing green leafy vegetables	Starting date of consumption
❑ Condiment to meals (kasha, potato, soup)	_____/____/86.
❑ Sorrel soup	_____/____/86.
❑ lettuce, salad from spring onions	_____/____/86.

11б. Did you cancel consuming green leafy vegetables following the accident **in April-May 1986:**

❑ yes ❑ no

11в. Put the date (at least aproximately), when did you cancel consuming ggreen leafy vegetables: _____/_____86.

Underline, please, how do you remember the events of April-May 1986 .

good **bad** **do not remember at all**

Please! Do not forget to take completed self administer interview with you while coming to the examination.

Dosimetry Interview

Instruction for filling in

Procedure of the interview.

Individual Interview Form is completed by interviewer during initial interview of subject ("S") and his accompanies. Given form is primarily designed for interviewing parents or accompanies of the subject (as far as the majority of questions refer to the period of April-May 1986). But if only examinee is presented He/She should be asked all the questions regardless the age. But if for "S" it is difficult to answer this or that questions referred to 1986 interviewer should use self-interview form. If the "S" does not have self-interview form or it is actually blank, the interviewer explains in details how it is necessary to fill in self-interview form and ask to fill it at home together with parents and then send it to the Institute

While conducting interview the interviewer should read all the questions without any additions and explanations from him/her-self. If the "S" or accompanying persons do not understand the question, the interviewer should ask clarifying questions which are presented in the given instruction

The questionnaire contains questions with overhead information for the interviewer (in Italic). Overhead information is not read out to the "S" or accompanying persons during the interview. During the interview the interviewer should use illustrative material in accordance with the given instruction.

Interview procedure

Put the date of interview.

Mark with "×" symbol participants of interview

Mark with "×" symbol if self-interview form is used, or if self-interview form is given home for filling in.

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1. *Put family name of "S". If at the time of the accident "S" had another family name, put it below.*
2. *Put the name of "S".*
3. *Put the patronymic of "S".*
4. *Mark if at the time of the accident "S" had another family name,.*
5. *Put the date of birth of "S" (day, month, for figures of the year).*
6. *Mark with "×" symbol gender of "S".*
7. *Put the name of the settlement where the "S" currently lives*
   7a Put detailed current address of "S"..(street, house, appt, phone N)
   7б. Name selsoviet,to which the settlement belongs.
   7в. Name raion,to which the settlement belongs.
   7г. Name oblast,to which the settlement belongs.
8. *Mark with "×" symbol appropriate variant of answer.*
9. *Name the settlement where subject lived at the time of the accident.*
   9a. Put the address (street, house, appt, phone N)
   9б. Name selsoviet,to which the settlement belongs.
   9в. Name raion,to which the settlement belongs.
10. *Mark with "×" symbol from what material the walls were made in the building, where subject lived at the time of the accident*
    10a. If the building was multistoried put the number of floor where subject lived at the time of the accident
11. *Put in the table information of "S" place of staying at the time of the accident and rout of the movements including week ends and holidays trips during the period* ***April 26 – June 30, 1986*** *In the field* ***"place of staying"*** *put Oblast, Rajon, Settlement where the S was. If it is the same as place of residence which is mentioned in the i.9 (i.7) put it once more to the table.*

*In the field **«Duration of staying»** in the column **«arrival»** put the date of arrival (day, month) to the mentioned settlement, in the column «departure» put the date of departure (day, month from the mentioned settlement . If the subject can not remind more or less exact date interviewer should suggest approximate date of arrival (departure) and put it in the column **"period"** (Abbreviated periods are given before the table in Latin. If the subject did not move from the place of the residence during the period April 26 – June 30 put dashes to the field **«duration of staying»** (do not leave this field blank).*

*In the field **"organization"**put kindergarten (school), if the S visited them at the place of residence; put summer camp, resting house (sanatorium) moved to (was evacuated to) summer camp, resting house (sanatorium); put hospital if the S was at hospital at that period.*

Additional questions to item 11.

12. *Put to the table information of 'S' movements from the place of residence for the period of more than 6 months. It could be move to a new place of residence, to the study, military service etc. In the field **"destination"** put oblast, raion, oblast, settlement where subject moved.*

*In the field **«duration of staying»** in the column «arrival» put approximate date of arrival (month year) to the mentioned settlement, in the column **«departure»** put approximate date of departure (month year) from the mentioned settlement.*

Additional questions to item 12.

13. *Pay attention that this question deals with the period **of 26.04 - 31.05.86.** Mark with "x"symbol appropriate variant of answer*

Do not suggest to 'S' variant "do not remember" as a possible answer.

Additional questions to item 13.

- *Did you take any medicines because of Chernobyl accident: pills, powders, mixtures etc. in the period* **April – May 1986?**

13а. *Mark with "x"symbol appropriate variant of answer*

Do not suggest to 'S' variant "do not remember" as a possible answer.

13б. *Mark with "x"symbol appropriate variant of answer*

Do not suggest to 'S' variant "do not remember" as a possible answer.

13в. *Suggest to 'S' illustrative material on iodine prophylaxis (Annex p.1) Mark with "x"symbol appropriate variant of answer. If no one of suggested answers is acceptable (subject suggests his/her own variant of answer not included to the list of options)put subjects answer as 9❑*

Additional questions to item 13в.

13г. Suggest to 'S' illustrative material with calendar for April-May 1986 (Annex p.1) If S could remind more or less exact dates of medicines intake put them to the calendar(cross the dates on the calendar) and shift to the question 14.. If S does not remember dates of intake shift to the next question 13d.

13д. *Suggest to S recall approximate starting date of stable iodine intake Mark with "x"symbol appropriate variant of answer.*

Additional questions to item 13д.

13е. Put the duration of intake (days).

Additional questions to item 13е.

- *During what period did you intake iodine containing medicines?*

13ж. *Mark with "x"symbol appropriate variant of answer.*

Do not suggest to 'S' variant "do not remember" as a possible answer.

14. *Pay attention! This question deals with usual milk consumption **before the accident.** Mark with "x "symbol appropriate variant of answer.*

Do not suggest to 'S' variant "do not remember" as a possible answer.

14а. *Only information concerning milk consumption **before the accident** is put to the table. Suggest to 'S' illustrative material of milk consumption (annex, p.2).*

*Asking S question: «What milk did you drink?» list suggested variants of**«Sources of milk»** and mark with "x"symbol appropriate variant of answer*

Do not suggest to 'S' variant "do not remember" as a possible answer.

*Asking S question: «How often did you drink milk?» list suggested variants **of«How often***

did you drink milk» and mark with "x"symbol appropriate variant of answer Mark with "x "symbol appropriate variant of answer.

Do not suggest to 'S' variant "do not remember" as a possible answer.

*In the field «**What amount of milk did you drink per day**» mark with "x"symbol appropriate variant of answer from the suggested variants, or in column «**other amount**» put other amount of milk in (litters), which S drank per day.*

14б. *Pay attention! This question deals with milk consumption **following the accident** in the period **April 26 May 31 1986**. Note, that «no» answer means that S did not move anywhere* during the mentioned period and continued drinking milk from the same source and in the same amount.

Mark with "x"symbol appropriate variant of answer

Do not suggest to 'S' variant "do not remember" as a possible answer.

Additional questions to item 14б.

- *Did you refused from milk consumption because of the accident in* the period **April 26 May 31 1986?**
- *Did you alter fresh milk to milk substitutes (milk powder, concentrated milk, condensed milk) because of the accident during the period* **April 26 May 31 1986?**

14в. *Interviewer should put into the table information concerning changes in milk consumption following the accident. Examples of filling in the table for the main variants of milk consumption are presented below.*

- *A Subject canceled drinking fresh milk in the mentioned period. In the **field «Changes in milk consumption»** put the date (day, month), when the subject canceled milk consumption. In case it is difficult for the "S" to remind more or less exact date, suggest him to recall approximate date (abbreviated names of time periods are presented prior to the table) and put it to the column **«period»**. In the field **«How often did you drink milk?»** Mark with "x "symbol variant of answer «не употреблял».*
- *"S" started using milk substitutes. In the field **«Changes in milk consumption»** put the date (day, month), when the subject started using milk substitutes. In case it is difficult for the "S" to remind more or less exact date, suggest him to recall approximate date and put it to the column **«period»**. In the field **«Source of milk»** put «dried milk». **Fields «How often did you drink milk?»** and **«What amount of milk did you drink per day»** will stay blank.*
- *"S" moved out from the place of residence during mentioned period. If "S" did not canceled drinking milk? The table is filled in for each place of "S" staying during the period April 26 – May 31, 1986 In the field **«Changes in milk consumption»** put the date (day, month), when the subject arrived to a new place. In case it is difficult for the "S" to remind more or less exact date, suggest him to recall approximate date and put it to the column **«period»**. In the field **«Source of milk»** put in what milk did "S" drink in the given place (sources of milk are given in Latin prior to the table) In the field **«How often did you drink milk?»** Mark with "x"symbol appropriate variant of answer In the field **«What amount of milk did you drink per day»** mark with "x"symbol appropriate variant of answer, or put in amount of milk (in litters), which "S" drank per day.*

Additional questions to item 14в.

15. *Pay attention! This question should be asked only subjects who **did not drink during the period April 26 May 31 1986** fresh milk. Suggest to 'S' illustrative material on consumption of dairy produce (annex, p. 3). Mark with "x"symbol appropriate variant of answer.*

Do not suggest to 'S' variant "do not remember" as a possible answer.

15а. *Interviewer should put into the table information concerning dairy produce consumption during the period April 26 May 31 1986.*

*In the field **«dairy produce»** Mark with "x"symbol dairy produce, which "S" ate.*

*For each mentioned dairy produce in the **field «how often did you consume dairy produce?»** mark with "x"symbol appropriate variant of answer*

*In the field **«How many grams of mentioned product did "S" consume per day?»** mark with "x"symbol appropriate variant of answer, or put in amount of diary produce (grams), which "S" consumed per day.*

Do not suggest to 'S' variant "do not remember" as a possible answer.

16. *This question should be asked only subjects, who drank cow's milk from private farm or goat milk. Suggest to 'S' illustrative material on starting date of cattle pasturing in spring 1986 (annex, p. 4). Put the date (day, month), of cattle pasturing. In case it is difficult for the "S" to remind more or less exact date, suggest him to recall approximate starting date of cattle pasturing. Mark with "×"symbol appropriate variant of answer.*

Do not suggest to 'S' variant "do not remember" as a possible answer.

If "S"remember, that during the whole period ***April 26 May 31 1986*** *a cow (goat) was not let pasturing (hay feeding), put «end of May» as a variant of answer.*

17. *Pay attention! This question deals with the period* ***April 26 May 31 1986*** *Suggest to 'S' illustrative material on green leafy vegetable consumption (annex p.5). Mark with "×"symbol appropriate variant of answer*

Do not suggest to 'S' variant "do not remember" as a possible answer.

17a. *Put into the table information concerning consumption of green leafy vegetables during the period April 26 May 31 1986.*

In the field ***«meals or condiments, containing green leafy vegetables»*** *Mark with "× "symbol in what form did "S" consume green leafy vegetables.*

In the field ***«When did you start consuming mentioned meals»*** *put the date (day, month), when the subject started consuming green leafy vegetables. In case it is difficult for the "S" to remind more or less exact date, suggest him to recall approximate date and put it to the column* ***«period»***.

17б. *Mark with "×"symbol appropriate variant of answer.*

Do not suggest to 'S' variant "do not remember" as a possible answer.

17в. *If the "S" could remind more or less exact date when he canceled consuming green leafy vegetables, put the date (day, month)).*

In case it is difficult for the "S" to remind more or less exact date, suggest him to recall approximate date Mark with "×"symbol appropriate variant of answer

18. *Suggest to 'S' illustrative material on measurement of thyroid in* ***April 26 May 31 1986*** *(annex, p.6).*

Mark with "×"symbol appropriate variant of answer.

18a. *It is necessary to reveal weather "S"was measured following washing (clean)*

Mark with "×"symbol appropriate variant of answer.

Do not suggest to 'S' variant "do not remember" as a possible answer.

Additional questions to item 18a.

- *Were you informed to come to the measurement washed up.*
- *Did you wash up before the measurement.*

19. *Mark with "×"symbol appropriate variant of answer*

Do not suggest to 'S' variant "do not remember" as a possible answer.

Additional questions to item 19.

- *Were you subjected to x-ray examination of head and neck caused by trauma with therapeutic purposes?*

19a. *Put how many times "S" was subjected to x-ray of head and neck (separately)*

Additional questions to item 19a.

- *how many times were you subjected to x-ray of head?*
- *how many times were you subjected to x-ray of neck?*

20. *Explanation: in diagnostic examination using radioactive medications it is injected to human body for examination, for example, function of kidneys, thyroid etc..*

Mark with "×"symbol appropriate variant of answer

Do not suggest to 'S' variant "do not remember" as a possible answer.

20a. **Put into the table information on therapeutic exposure (radioisotope diagnostics)**

If x-ray therapy was conducted put it into the field «Treatment».

If radioiodine diagnostics was conducted put it into the field ***«Diagnostics»***.

In the field ***«Disease»*** *put the reasons of treatment or diagnostics*

In the field ***«where»*** *put the name of medical facility where the "S" was subjected to such*

procedure, also put a city were this medical facility was located.
*In the field «**when**» put month and year, when the procedure was conducted.*

Strictly follow this instruction.
Stay in the framework of suggested format of answers putting in, do not make any marks and comments on the fields.

After filling in the dosimetry interview form should be passed to _____ and stored in the Dosimetry Laboratory.